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Vol. xx DECEMBER, 1915. No. 12

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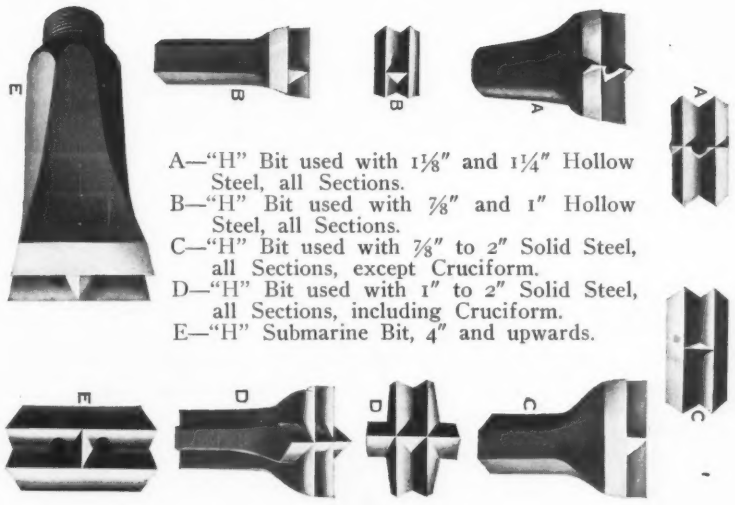

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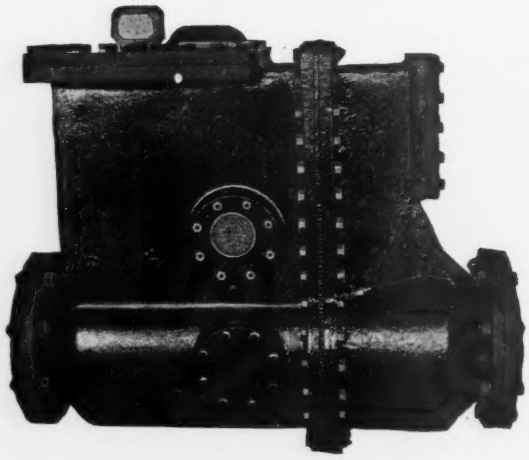

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915.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC.

Vol. XX DECEMBER, 1915 No. 12

THE FUNCTION OF A NAVAL EXPERIMENTAL LABORATORY*

The recommendation of the Naval Consulting Board that a physical laboratory be established on tide water for the conducting of experiments by the Government seems to have been misunderstood. It is not true that it is proposed that such a laboratory should be under the direction of the civilian board. On the contrary it is to be controlled and directed by the United States Naval officers.

It is not true that the civilian board, or any other board of inventors, is expected to go within the walls of this experimental station and invent or produce devices for the use of the navy. The proposition is that this shall be a great physical workshop for the purpose of trying out and developing inventions which will have been submitted from all sources to the United States Government.

When such inventions are submitted and are first passed upon by the regular naval engineers, it is proposed to submit them, or some of them, to the civilian consulting board for advice and information, and when such advice is received by the naval engineers, and they elect to go further into the suggestions made, then the physical laboratory will be a means by which it may be determined whether or not an invention is a practical one.

The Naval Consulting Board is, as its name implies, a board of consulting engineers and not necessarily a board of inventors. They are not expected to originate plans or practices to any greater extent than all the people of the United States are expected to do so. Their position is identical with that of any other individual in the United States who may have a suggestion to put before the Government, the difference being that in the case of the Consulting Board they may be called upon by the naval engineers to express their opinions, to give advice, and perhaps personal assistance, in the development of ideas.

The members of the Naval Consulting Board are responsible to no one except to the societies which elected them. They are in no way Government employees or officers. They receive no compensation from any source, and they pay their own expenses.

The United States Government has now two large and many smaller experimental stations. The principal one is the Bureau of Standards at Washington, under the Department of Commerce, where a great deal of scientific work is being done in the nature of research and investigation. There is also the Bureau of Mines, where research and experimental work is conducted in metallurgy and chemistry. At various navy yards in the country there are experimental stations, but at no place is there a plant at tide water where actual physical work may be done in the way of building machines on a large scale for the purpose of demonstrating to the satisfaction of the United States naval officers whether or not an advance may be made in naval practice. Such a station could be no small affair, for to be of real value it should be so equipped as to reach results expeditiously and thoroughly. In other words, it should do for the Government what Edison's laboratory has done for science and what the

*From an article in *The Engineering Magazine*, November, 1915, by W. L. Saunders, Vice Chairman of the Naval Consulting Board, and President of the American Institute of Mining Engineers.

General Electric Laboratory has done for that company.

Experimental or development work is necessarily expensive, but our experience in the past would seem to warrant us in believing that it is better to spend money in trying out and perfecting devices for naval service rather than to depend upon the natural course of events during which developments take place slowly through other sources, and in the end individuals or other nations get the benefits that might accrue to this Government. We have only to cite two recent cases of importance—the submarine and the aeroplane—to realize that the American navy would have been far more advanced had the Government taken up through its own physical station the early inventions of Holland and the Wrights. It is work of this kind that can best be done through a large and well equipped physical laboratory under the control of the Government. The man who has had more experience in this line than any other and has achieved a greater success is undoubtedly Mr. Edison. The proposed plan for this research station is his. His greatest work has been acquired through research and experiment. Before he invented the storage battery he tried more than ten thousand experiments, always aiming at a certain result, which he finally achieved. The General Electric Company have found it of the utmost value to spend hundreds of thousands of dollars in research work. It has paid to do it, and why should we hesitate to follow the same lines in protecting and strengthening the greatest and richest of nations? The proposed physical research laboratory, even at the maximum figures placed by Mr. Edison—five million dollars, represents only about one-third the cost of a large battleship. Is it not best to first make sure that we are building this ship right, and in advance of the practice of other nations, rather than plunge forward at large expense and in the end discover costly mistakes? America has long been the birth place of the greatest inventions. Let us utilize this creative force in increasing the safety, strength and efficiency of the nation.

The visible smoke and steam that come out of a plant may indicate industry, but at the same time they indicate inefficiency and wastefulness.

SINKING OF THE WOODBURY SHAFT AT THE NEWPORT MINE, IRONWOOD, MICH.*

The Woodbury shaft, which is now being sunk by the Newport Mining Company at Ironwood, Michigan, is a vertical shaft at right angles to the strike of the formation. The over all dimensions are 21 ft. 1 in. by 13 ft. 1 in. with six compartments which will accommodate two skips, two cages, one ladder road and necessary piping. The first 100 ft. of sinking was in quartzite; from 100 ft. to 715 ft. were alternating strata of gray and red slates and quartzite. Below this is granite.

The surface equipment, as much as possible, was complete before sinking operations were started. During the sinking of the first 700 ft. practically all of the hoisting was done in three compartments by a single drum hoist operated by a 50-h.p. motor, and a double drum hoist operated by a 70-h.p. motor. Three belt driven compressors, Ingersoll-Rand, Imperial, Type 10, each driven by a 50-h.p. motor, furnish air, at 90 to 100 lb. gage, to 12 Jackhamer drills. The air line, which is 6 in. wrought iron pipe, is for permanent use.

THE HEADER FOR HANDLING THE DRILLS.

This device shown in photo on Fig. 1 and in detail in Fig. 2 is a departure from ordinary practice. The header distributes the air to the drills and provides a safe and handy place for hanging them when not in use, one Jackhamer being shown on its hook in Fig. 2. When ready to drill, all that is necessary is to remove the Jackhamer from the hook and pull downward, the counterweight F keeping the slack hose out of the way while drilling.

In Fig. 2, A is a casting 9 in. in diameter, bored out in the center, and having a bolt circle of a standard 4 in. flange. Eight holes, evenly spaced, are drilled in the sides and tapped for ¾-in. nipples, to which the machine hose connections are made. B is a duplicate of A, with the exception that the holes for the nipples are of a different size. There are seven ½-in. connections and one 1 in., the latter being an inlet for the water and the others for water discharges to the drills. The

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*Abstract of a paper by J. M. Broan, Mining Engineer, Newport Mining Co., before the Lake Superior Mining Institute.

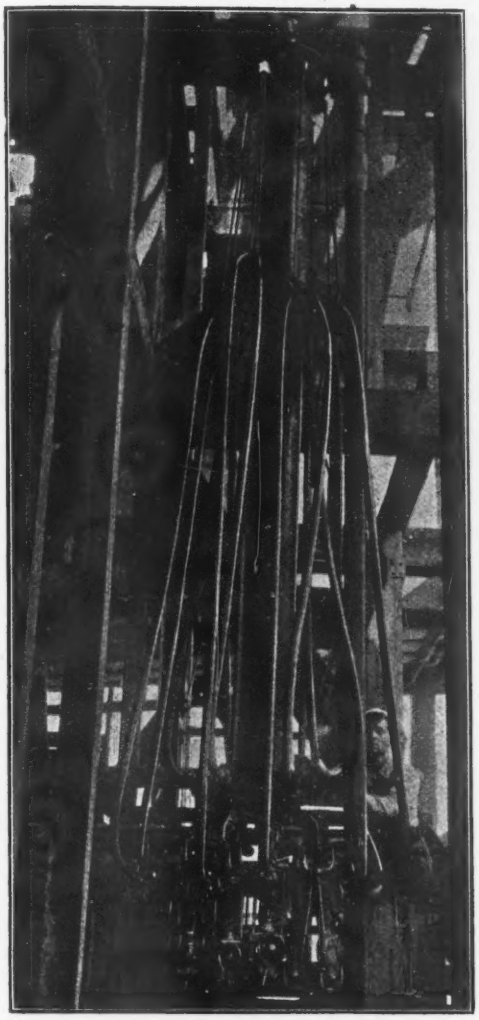


FIG. 1.

hooks or hangers marked C are made of ⅜ by 2 in. strap iron. There are four of these with a hook on each end. A B and C are all held together by four ¾-in. bolts passing through the 4 in. flange at the bottom of the 4 in. air pipe E. The ell at the top of the pipe is a special casting with a lug for the 1 in. eye bolt by which the header is suspended. D is a 9 in. pipe which serves as a casing to enclose the counterweights F.

Two of these headers are used, each accommodating seven jackhamers and one blowpipe, but only six machines are used on each at present. When in use each header hangs on a

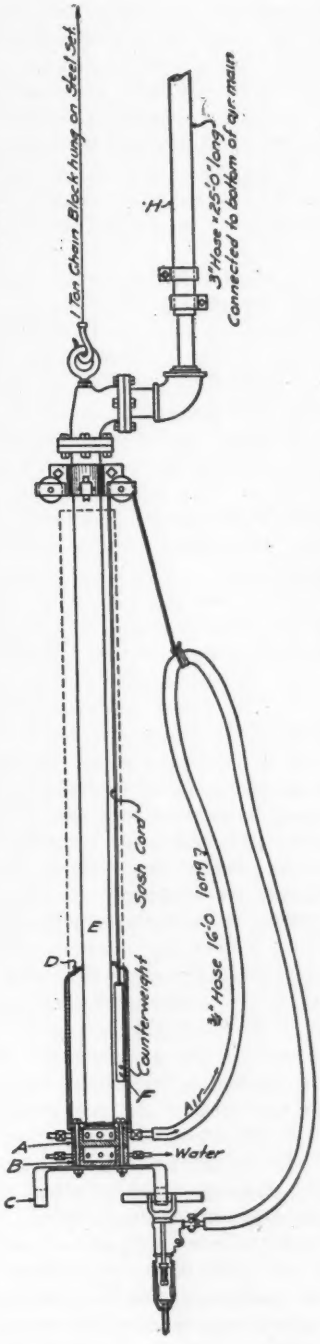


FIG. 2.

small chain block fastened to the bottom shift set. By means of the chain block the apparatus can be brought to any desired height, the adjustment being allowed by the use of a 3 in. air hose H, which connects to the air main, the bottom of which is always far enough up the shaft to avoid any severe blows when blasting. One of these outfits can be taken from its position on the surface and placed on the chain block below ready for drilling in less than five minutes.

While in the softer slates water tube pistons were used, and air was blown through them in place of water. A short piece of ⅜ in. rubber hose, shown in Fig. 3, delivered air from the ¾ in. air hose to the tube connections. Later when drilling in the granite the drilling speed was not as great, and it was found that sufficient air could be supplied through the ordinary piston to clear the choppings from the drill. The water tube pistons were then replaced by the ordinary pistons, and the bypass hose dispensed with, thus giving greater efficiency in air consumption, but no noticeable decrease in drilling speed. The steel, which is ⅞ in. hollow hexagon, is made up into lengths varying by 1-ft. changes from 12 in. to 10 ft., with ⅛-in. difference in gage for each drill; the first bit being 2¼-in.

Until the granite was reached, the four-point or cross-bit was used, but the wear on the gage became such as to warrant a change if something more serviceable could be found. It was then that the Carr bit was tried out. Considerable difficulty was encountered, especially in the stratified rocks, with fissured holes and stuck drills. Rather than abandon a hole much time was often spent in freeing a drill. It was here that necessity led to the adoption of the two pullers shown in Fig. 3. In case only a short portion of the steel emerged the long gooseneck, shown on the left, was used, while if two or more feet of the drill remained out of the hole, the shorter puller, shown on the right, could be applied. In either case the inverted jackhamer supplied the necessary power to extract the drill. While in the soft slates 10 ft. drills were used with very little difficulty, and sinks measuring as deep as 9 ft. have been blasted successfully. About 470 lin. ft. of drilling was required per cut in these slates and this could be completed in from 4 to 5 hours. In the hard quarzite dike and granite the gage on the steel would not hold up

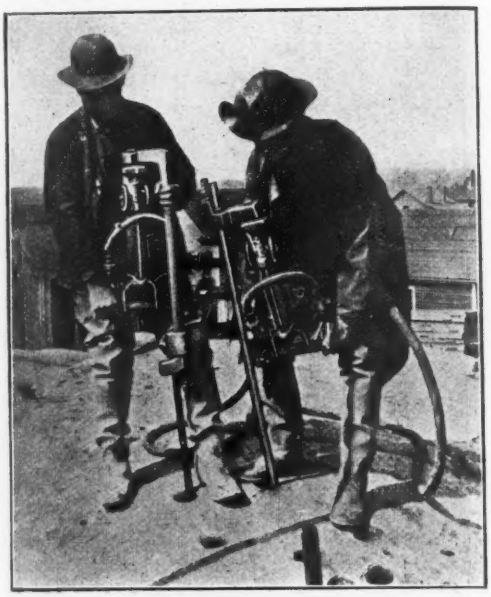


FIG. 3.

long enough to permit the use of any drill over 8 ft. long.

In these rocks about 425 lin. ft. of drilling is necessary, which can be done in 7 or 8 hours. The breaking of the holes is dependent entirely upon their arrangement and the order in which they are fired. Fig. 4 shows the plan and section of the arrangement and order of firing used while in the soft slates. Line AA represents a bedding plane on which the rows No. 1, 2 and 3 on the right were bottomed. The shaft was blasted in two separate blasts, the first being made on the right, and the holes blasted in the order numbered in the plan. Three holes marked No. 1 were fired simultaneously with No. 6 electric blasting caps. The exploders in the remaining holes were made up of No. 8 caps and electric delay fuse igniters.

A different arrangement of drilling and order of firing has been found more satisfactory in the granite. Fig. 5 shows 2 rows of holes marked No. 1 which are drilled about 5 ft. deep at an angle of 60 degrees; then 2 rows marked No. 2 about 8 ft. deep at an angle of 70 degrees. These 4 rows of 5 holes each comprise the cutting holes, which are fired in the order numbered in the plan. The 6 No. 1 holes are fired with No. 6 electric blasting caps,

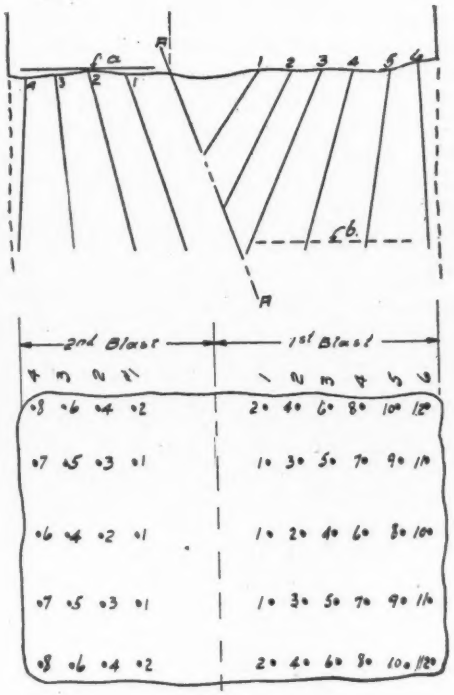


FIG. 4.

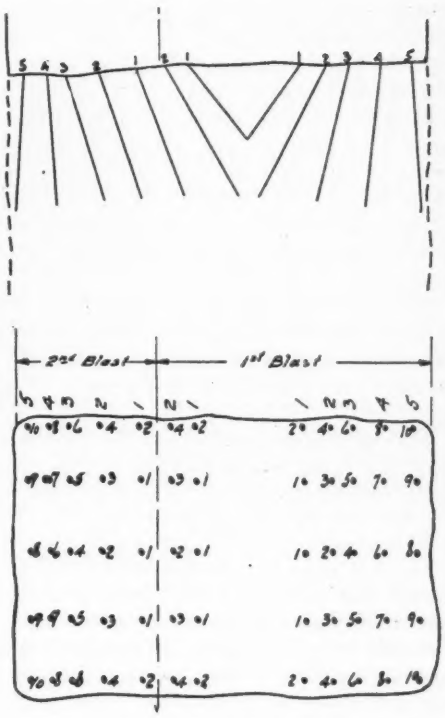


FIG. 5.

and the others with No. 8 caps and electric delay fuse igniters.

Since the steel used is only ⅞-in. in diameter, the bottom of a deep hole is, of course, very small and can not contain sufficient explosives to break the burden in a satisfactory manner. To offset this disadvantage as much as possible, without drilling more holes, two or three sticks of 100 per cent. blasting gelatine is placed in the bottom of each hole. The remainder of the charge with the exception of the cartridge containing the detonator is 80 per cent. blasting gelatine. Experiments by the DuPont people have shown that 60 per cent. nitro-glycerine gives a maximum efficiency for speeding up the action of a charge, and for this reason a single cartridge of this strength is used to contain the detonator. It is placed as near the top of the charge as considered safe from being cut off by the breaking of an adjacent hole. Cartridges of sand are used for tamping. An average of 26½ lbs. of explosives per foot of shaft have been used in the first 800 ft. or about 1 lb. for every 13 cu. ft. of excavation. In the first 1100 ft. about 2 lb. of explosive was used per cu. yd. of rock excavated.

After a blast the smoke is cleared away by means of a draft forced through a 12-in. pipe by a 7-h.p. fan, on surface. At first the fan was used to draw the smoke out, but by reversing the air current a marked advantage was noticeable in the time required to clear the smoke.

During the first 700 ft. of sinking the rock was disposed of by means of three buckets having a capacity of 26 cu. ft. each. In order to make shoveling as easy as possible, steel plates have been used as sollars, with considerable success. In Fig. 4 "A" shows the position of these plates, when the first blast is made. The breaking of the holes in this blast has a tendency to throw the rock to the position of the plates. In the second blast of the same cut the plates are placed in position "B" Fig. 4.

During the mining operations below the construction crew is employed placing sets, ladders, etc., above. All lighting is done by electricity. A single lamp is placed under each

ladder sollar to light the ladder to the sollar below. At the bottom of the shaft, two clusters of four lights each are hung, one below the staging to give light to the miners and one above to give light to the construction crew. An electric signal system is used, the wires being run down the east side of the shaft beneath the ladders. By means of a jumper connected to a common return wire, either signal bell can be rung from every sollar.

The men employed in the shaft are as follows: One shaft captain, 3 shift bosses, 36 miners, 11 construction men, 1 electrician, 4 landers, 2 motormen, 4 hoist engineers, a total of 62 men.

The excavation commenced on March 1, 1915, and 1,129 ft., or one-half of the total depth, was completed in the first six months.

SAFETY.

The first step along the line of accident prevention was the use of hard hats. In order that no excuse can be made, every man is furnished with a hat made of felt treated with rosin and shellac. These hats are very hard and will resist a severe blow. No person is allowed to enter the shaft without one. Danger signs are placed in conspicuous places warning loafers to keep out. Movable sollars made of steel plates and operated by levers, are placed over the two compartments most used for loading supplies. When the bucket hangs at the brace the lever is thrown and the plates close in around the bucket making practically a complete cover of the compartment. All buckets when lowered from surface are stopped just above the point where the construction crew is working and are rung down from there by the men below. Owing to numerous infections in minor wounds, an antiseptic consisting of a 2 per cent. solution of lysol has been placed in the wash room used by the shaft men. To date no accidents of a serious nature have occurred.

COMPRESSOR CYLINDERS VICTIMIZED BY A SUPERINGENIOUS "ENGINEER"

An engineer was hired to operate this plant after it was put in service, and to familiarize himself with the equipment and keep an eye on the construction work he was put to work while the plant was under erection.

Part of the equipment was a small ice machine, with the usual compressor. While the erecting engineer was installing it, the engineer inspected the cylinders, which of course were not as smooth as they would be in a machine that had been run for a while, and he told the erecting engineer that he thought they were altogether too rough. The latter explained that they would wear down as smooth as glass in a couple of weeks or a month at the most, and that all new machines were that way.

After the erecting man had left, the engineer decided he would hurry the smoothing operation. There was a bag of fine emery left, which some of the erectors had used for grinding-in valves, and the engineer mixed this with oil and pumped a liberal dose into the steam and ammonia cylinders. After a couple of days he gave them another dose and still another at the end of the week, telling the oiler he was going to have a polish like looking-glass in a little while.

About a month later, answering a hurry-up call, the erecting man found that the head pressure was low and the back pressure high, indicating that the machine was too small for the system, which he knew was not the case. He placed the wristplate on the central position, opened the indicator connections and turned the steam on. To his surprise steam at apparently full pressure blew out of each of the cylinders. He removed the valve bonnets and examined the valve setting, which was the same as he had left it. Then he pulled out one of the valves. This bore a sorry resemblance to the one he had put in there a month before.

While the oiler and he were working, the former casually remarked that "Ben's emery and oil wouldn't put much polish on cylinders in such a condition." The erecting engineer nearly dropped his wrench, but managed to appear unconcerned. In a matter-of-fact way he answered that he did not think it would, and inquired how they had used it and how much. The next day two men with a boring bar were busy on the machine and one engineer was out "scouting" for another job.—*Thos. G. Thurston in Power.*

Gas and oil engines innumerable were exhibited at the Panama Pacific Exposition, but not one steam engine.

AIR CUSHIONS FOR ELEVATORS

BY FRANK RICHARDS.

There recently occurred in one of the large office buildings of New York what might easily have been a serious and perhaps fatal accident. This building, of very large area, although it is now not quite up to date for the locality, as it is only sixteen stories high, is served by a row of eight passenger elevators and one big freight elevator. These elevators are hydraulically operated, not by a long direct plunger but by a plunger of larger diameter and shorter travel with multiplying cables and sheaves to give the required lift.

These passenger elevators in the rush hours, morning and evening, and also at noon, are apt to be crowded to their capacity, and on the day spoken of, when the lunch hour rush was on, the water pressure pipe was broken off, thus suddenly letting off all the plunger pressure, and seven of the eight cars, mostly full of passengers, dropped from different heights to the bottom. No one was hurt, so that not a very big story could be made of it by the daily papers, but it was given out that the safety of the elevators, as thus apparently demonstrated, was due to the action of the air cushions.

As a matter of fact these elevators have no air cushions, and, speaking after the manner of men, it might rather be said that serious accident in this case was escaped rather by pure luck. The safety devices provided surely can claim no credit in the matter. The cars really did not have the absolutely free drop which we think of when accidents of this type occur. Not one of the hoisting cables was broken; they all held intact and retained their places upon their respective sheaves, the counterweights all remained fully effective, and of course the friction of all this apparatus had more or less braking effect; also, although the water pressure pipe gave out completely, the entire release of the sustaining water pressure, and the escape of the water from all the hoisting cylinders, could hardly have been instantaneous. These things doubtless concurred to check the rapidity of the descent of the cars, thanks to nobody.

In the elevators here spoken of there is not the slightest attempt to confine the air in the shafts for cushioning or safety purposes. There are in fact no individual shafts, the eight cars all traveling, with suitable guides, in one open space with no partitions between them, and also at each story the doors and the entire elevator front consist of open steel lattice work.

This conspicuous absence of the air cushioning device suggests the propriety of a little general remark upon the subject in the interest of public safety. Air cushions would seem to be almost the ideal safety device for elevators. They are no man's special invention, they do not necessarily involve any patented apparatus, it has been to no man's particular interest to push them, so that for these and similar reasons they have not been urged for adoption as have been many things less deserving. Nevertheless no big modern building can be said to be up to date without them, not only for their first ostensible safety function, but also, as will appear, as an essential detail in effective fire protection.

To those who have never given it a thought there is one rather surprising thing in the functional operation of an elevator air cushion, and that is as to the air pressure involved. There is one elevator in the world which is unique, and which may be said to be perfect as to its air cushion. This is an elevator built at Chicago for amusement purposes. The shaft of this elevator is a steel framed, glass lined cylinder 200 feet high and 30 feet in diameter. It carries a load of passengers in its car, up to 125 at a time, from the bottom to the top with a lookout through the glass all the way up and a free view in all directions when the top is reached.

PASSENGERS BLOWN UP THE SHAFT.

The passengers in this elevator are not hoisted by any of the usual means, but are literally blown up. The elevator car is practically a piston fitting the interior of the glass lined cylindrical shaft approximately air tight, and air pressure is applied under the car to do the lifting. And here is the wonder of it. All the air pressure required to lift the weight of the elevator car, and the maximum load mentioned of 125 passengers, is only a quarter of a pound to the square inch. No air compressor, but just a common foundry blower is all that is required to operate this elevator.

In making the ascent in this elevator, when the top is reached or at any point below the

top, if the blower is stopped or if the inflow of air ceases, the car is still sustained by the cushion of air under it, and, as the car or piston must be assumed to be not perfectly air tight in the cylinder, some of the air will leak past the car and it will slowly descend to the bottom, air-cushioned all the way, but with the air pressure under it never greater than that due to the weight of the car and its load of passengers, or, as before stated, about ¼-lb. per sq. in.

This would be the case if the conditions were as described, but if the air cushioning operation should begin after a car had freely dropped a considerable distance, and after it had acquired a high velocity, then the air pressure required to check and overcome this velocity would be much greater, and if the additional distance to be traveled was small and the time allowable for the stoppage short, then the air pressure under the car might be too high for safety.

A personal acquaintance of the writer, probably forty years ago, who was an enthusiastic advocate of the safety air cushion, undertook to give a demonstration of it in connection with an elevator in Boston. Unfortunately he was not an engineer and was deficient in mechanical instinct, so that he gave no proper thought to the conditions essential to success and safety. At the bottom of the elevator shaft he built a cushion chamber of brick, too short to be called a shaft, into which the car was to drop and be cushioned by the air. On the first and only trial that was made he got into the car and was lifted to the top of the shaft, the cable was cut by his order, the car had a perfectly free drop to the bottom, the brick air chamber flew all to pieces and the poor fellow was killed.

Since that time the subject has been intelligently and thoroughly studied and there is now no guesswork or uncertainty about the elevator air cushion any more than there is about the means of lifting. It was remarked at the beginning that no specific inventions and no great ingenuity were required in the construction of the air cushion, but in bringing it so near perfection as it may now be claimed to be several valuable devices have developed which are now apparently indispensable.

Another surprise awaits the novice here in the small amount of air pressure required for effective cushioning when the work is properly distributed. The trick of it is to have a sufficient length of cushion shaft, so that a proper distance will be traveled and a proper time will be consumed for the cushioning operation.

Probably as typical as any of the up-to-date elevator air cushions are those of the Woolworth Building, and they could have no better opportunity anywhere. There are in the building 26 elevators traveling at a hoisting and lowering speed as high as 700 feet per minute. Two of the cars travel to the fifty-first story, 679 feet, two to the forty-sixth story, two to the fortieth story, and so on, four traveling only to the twelfth story. The air cushions for these elevators extend up to the fourth story for the lowest lifts and to the eleventh story for the highest. The shafts for the lower portions where the cushioning occurs are thickened and stayed to resist the internal pressures that will occur. The fit of the car bottom in the shaft of each is adjusted and graduated with care, so that there will be an approximately uniform pressure for the cushioning for the entire cushioning distance, and no excessive pressure at any point. There are in fact outlet valves distributed in the shafts and set to open at a pressure of about 12 pounds. The sudden pressures would of course rise above this in case of a drop. As the cars fit the shaft so closely there would be a power-consuming suction when lifting, and this is prevented by free moving automatic inlet valves. In the shafts above the cushioning portion there is space enough around the car to make the air resistance negligible.

The air cushions of these elevators have been subjected to practical tests under the most exacting conditions possible and their absolute safety and reliability have been fully demonstrated. As a sample incident, one of the cars loaded to a total weight of 7,500 lb., equal to that of a carful of passengers, was dropped freely from the forty-fifth floor and stopped by the air cushion with perfect safety. The car velocity in the cushion portion of the shaft was not checked with great suddenness, but gradually and with a nearly uniform resisting pressure, which did not exceed 15 lb., per sq. in. except at the last moment when a maximum of 18 lb. occurred.

Such being the facts in regard to the guar-

antee of safety which the air cushion gives to the elevator it would seem that its adoption should be as compulsory as that of a safety valve on a steam boiler, unless a device equally effective could be found, and there is none in sight.

The completely air tight enclosure of the shaft and the normally tightly closed doors which the air cushion demands are in all cases continued to the top of the shaft. This, while not necessary at the upper end of the shaft so far as the action of the air cushion is concerned, is a very important detail for the purpose of fire protection. The tight shafts and enclosed stairways completely isolate each floor from all the rest and prevent the extension of incipient fires, so that for this reason also the air cushion, and the conditions which it implies, should be insisted on, and in the most modern buildings they are so almost universally.

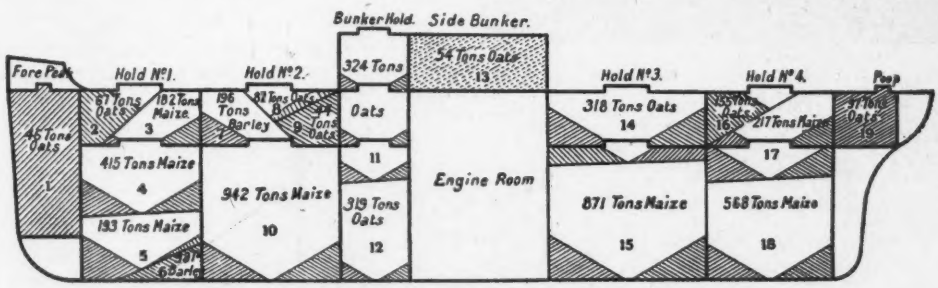


FIG. I. TYPICAL STORAGE PLAN OF A GRAIN-SHIP.

PNEUMATIC GRAIN ELEVATING PLANT*

Although the first successful pneumatic grain handling plants were constructed as much as twenty-five years ago, real progress can only be said to have been made in this direction in recent years. One of the early drawbacks was the great consumption of power. But, even with such an extravagant consumption of energy as 4 horse power per ton per hour, it was found that the early pneumatic apparatus possessed very definite advantages over mechanical means for some classes of work.

Pneumatic systems are coming more and more into favor for grain in cases where it would be difficult, if not impossible, to utilize purely mechanical means, while in many instances it will be found advantageous to have the two systems working together, the mechanical elevators taking out the contents of the main holds of ships, while the pneumatic appliances are left to deal with the discharging of the grain which is inaccessible to the former.

There are three main uses to which pneumatic plants can be applied with advantage:— First, for discharging ocean-going vessels in port, and especially for cargoes consisting of a number of comparatively small parcels of various kinds of grain, which render the speedy and efficient discharging of the cargo a far more difficult task than is the case with ships carrying only one large consignment. This point is well illustrated by the accompanying diagram, Fig. 1, showing the actual stowage plan of a grain ship dealt with at a Scottish port. The cargo consisted of a large number of parcels of grain varying in size from 46 tons to 942 tons, which were stowed not only in the main holds, but also in the side bunkers, peak, and poop holds. In such cases ordinary bucket elevators are at an obvious disadvantage, as a very large amount of the work of discharging would have to be done by manual labor, which is both slow and expensive. With a pneumatic plant, on the other hand, the flexible piping can be introduced through any small opening or carried inside the vessel any distance so as to deal with the parcels stowed away in awkward corners of the ship. The cargo in the ship illustrated diagrammatically weighs altogether 5,188 tons, and if bucket elevators and manual labor only were available for discharging, probably 1,626 tons, or nearly 33 per cent., would be required to be "trimmed," as indicated by the cross section lines shown.

A further advantage claimed for the pneu-

*Condensed from *The Engineer*, London.

FIG. 2. PNEUMATIC GRAIN ELEVATOR FOR MANCHESTER SHIP CANAL.

matic system is that the work of discharging can be continued in all kinds of weather, as the hatches need only to be opened slightly to admit the suction pipes, and the grain is thereby protected from the effects of rain and wind. Still another advantage claimed for the pneumatic system is the beneficial effect of aspiration on the grain, particularly that which has become heated by storage for a length of time in the ship's hold. In passing through the apparatus the grain is cooled, and the dust which is removed can be returned, if necessary, for weighing purposes.

WHERE TO USE PNEUMATIC ELEVATORS.

In the cases of mills to which the grain is delivered in barges there are several points for consideration in deciding whether to adopt a bucket or a pneumatic elevator, such as, for instance, the comparative cost of labor and power; whether the water frontage is suitable for the employment of bucket elevators; whether the berth is large enough to enable the barge to be moved about—a necessity with the bucket elevator; whether in the case of tidal water there is stranding at low tide; and

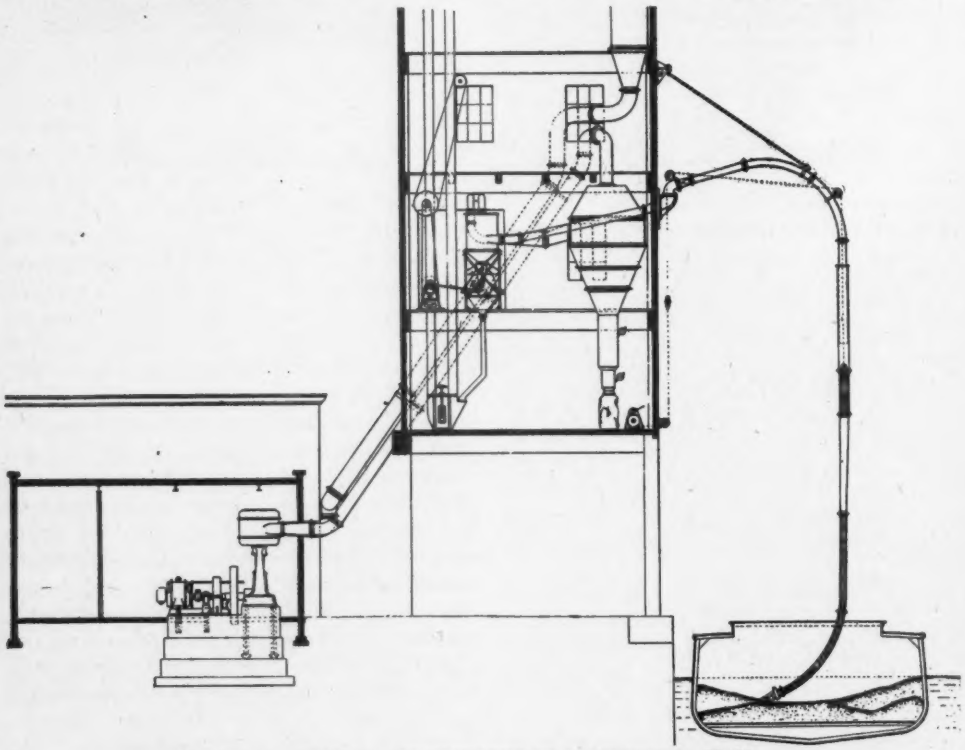


FIG. 3. GENERAL ARRANGEMENT OF MANCHESTER PLAN.

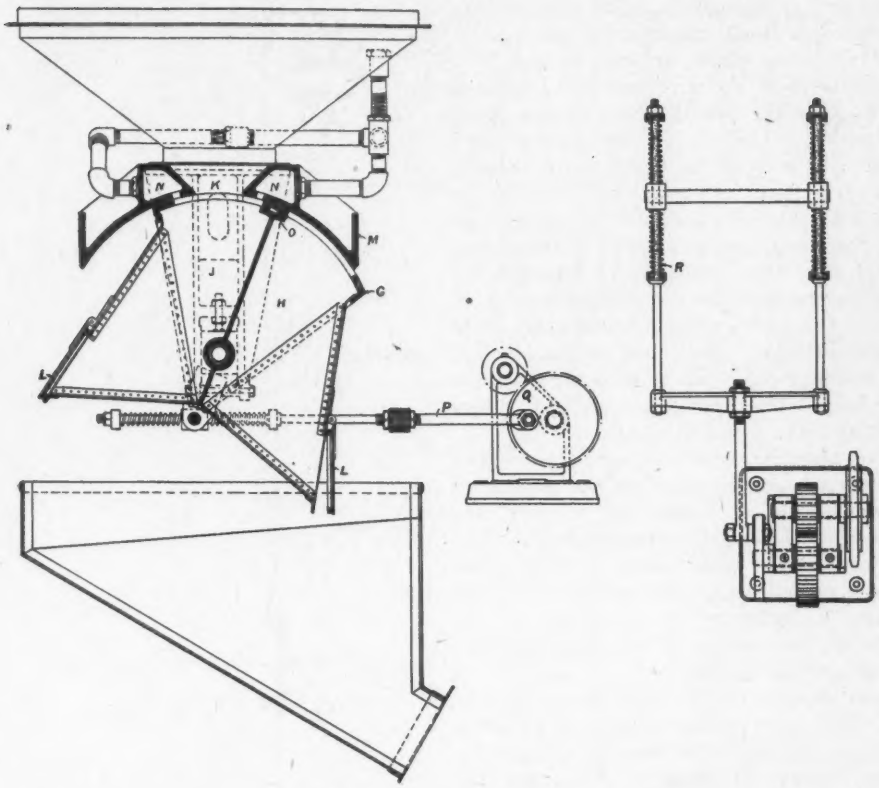


FIG. 4. DISCHARGE TIPPER SEAL.

finally the rise and fall of the tide. It will be admitted that as regards the power consumed the advantage will be with the bucket elevator, but as a set off to this it must be borne in mind that in passing through the pneumatic plant the grain is subjected to a cleansing action, and the work of the cleaning machines is thereby reduced.

Some illustrations are here given of a pneumatic grain elevating plant of 50 tons per hour capacity which has recently been erected by Henry Simon, Limited, Manchester, at the mill of John Jackson and Sons, Salford. This plant has been specially designed for unloading grain from barges in the Manchester Ship Canal, Fig. 2. The general arrangement of the plant is shown in outline in Fig. 3. The principal features are: an electrically driven vacuum pump, which it is not necessary to describe here, an improved form of discharging apparatus, Fig. 4, and telescopic grain suction pipes, Fig. 5.

The suction branch of the vacuum pump is connected by a 16 in. sheet steel main to a cyclone dust collector fitted with discharge valves to enable the dust extracted from the grain to be discharged into sacks. The inlet to the dust collector is connected to the grain receivers, in which the grain after being freed from dust is deposited. From the receivers the grain is discharged through the mechanically operated tipper seal shown in Fig. 4. The rocking member G contains two pockets H J, which are alternately brought into communication with the grain outlet K of the receiver. While each pocket is thus engaged and therefore under vacuum its hinged discharge door L is held closed by the pressure of the atmosphere. Simultaneously the other pocket has been swung far enough over to admit air through the feed opening and has permitted the hinged door to open and discharge its contents. The frame of the tipping box, including the circular rubbing face, is of cast

iron, and is pivoted in adjustable bearings, the bearings being supported by brackets carried from the upper or seat casting M in which ports N are arranged for exhausting the air from the pockets before grain is admitted to them. The object of the latter arrangement is to prevent the inrush of air carrying the grain over and into the dust collector. The air-tight joint between the tipping box and the upper casting is made by two means. There is a steel packing strip O held in the cross bar between the two pockets against the face of the upper casting by bow springs, and at the sides and ends of the rubbing face of the tumbling box leather strips are provided. The hinged discharge doors are also rubber faced to make an air-tight joint.

The tumbling box is caused to oscillate through the desired angle by the mechanism shown in Fig. 4, comprising a crank and connecting-rod P and mechanism operate d by a train of spur gear wheels Q. This gives ten tips per minute, which is sufficient to pass 25 tons of grain per hour. Interposed between the connecting-rod and the tippers are helical springs R, the object of which is to prevent damage to the apparatus in case of any solid body becoming jammed between the cross bar of the tipping box and the lip of the seating. It should be mentioned that the crank mechanism is adjustable to allow for the normal compression of the springs.

The grain and air enter the receiver in a tangential direction by way of a fixed pipe communicating with the movable intake piping. The latter is supported by means of a swivel joint enabling it to be slewed through an angle of 180 deg. in order to obviate the necessity of moving the barges more frequently than is absolutely necessary for discharging purposes. A feature of the intake piping is the rectangular section to prevent the concentration of the grain, which would cause undue wear and tear.

Another interesting feature of the intake piping is the special telescopic joint shown in section in Fig. 5. This enables the height of the nozzle to be varied to the extent of 10 ft., according to the level of the grain in the barge. It will be observed that in this arrangement the upper pipe slides inside the lower one to prevent the grain falling between the joint and causing jamming. The packing joint comprises a ring of soft self-lubricating

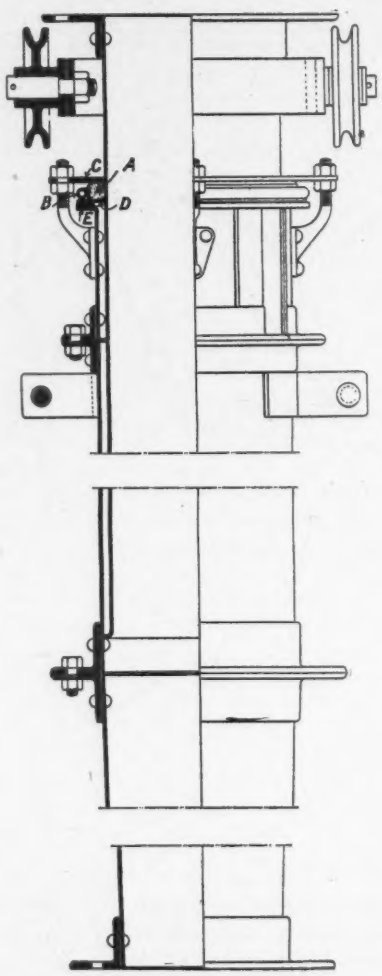


FIG. 5. TELESCOPE GRAIN PIPE.

packing A, held in place by means of a spring B and a bolted flange C. The packing rests upon a loose ring D, between which and the flanged end of the lower pipe is a rubber ring E. The whole of the packing can be readily taken to pieces by removing the nuts shown. The lower end of the pipe is raised or lowered by means of wire ropes carried over guide pulleys.

A typical form of suction nozzle is illustrated in Fig. 6. It is built up of wrought iron plates acetylene welded and riveted, and consists of three parts, two of which form the duct by which the grain enters, and between these is the annular air chamber through which surplus air is admitted. The amount of air

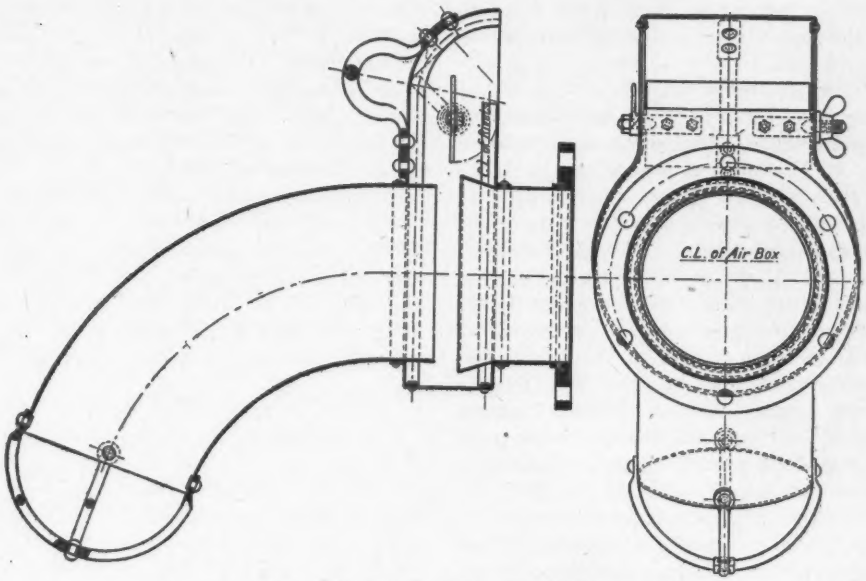


FIG. 6. GRAIN SUCTION NOZZLE.

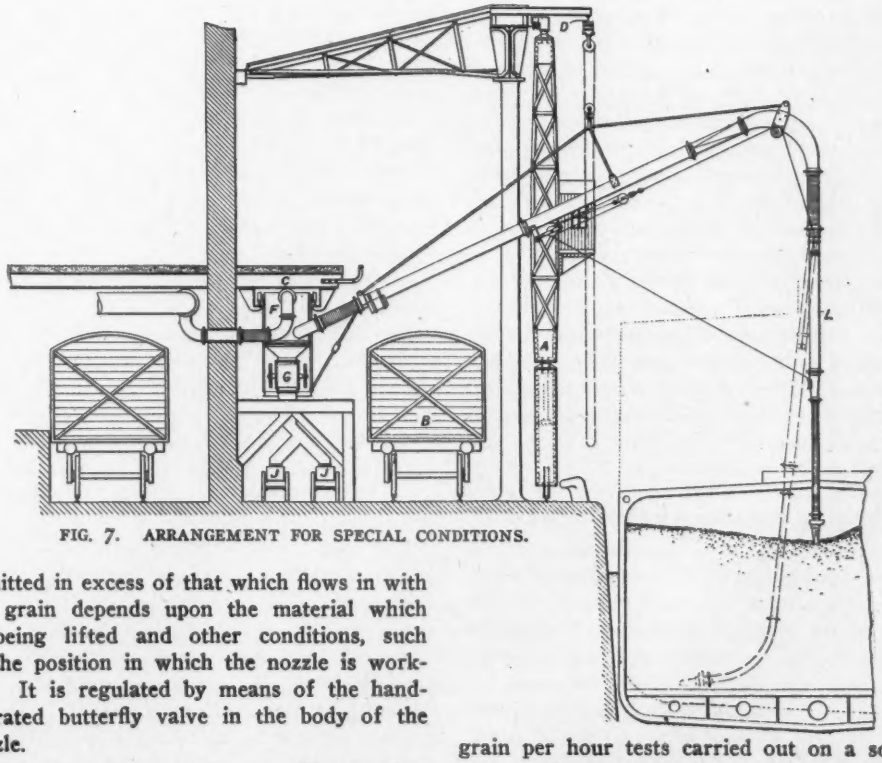


FIG. 7. ARRANGEMENT FOR SPECIAL CONDITIONS.

admitted in excess of that which flows in with the grain depends upon the material which is being lifted and other conditions, such as the position in which the nozzle is working. It is regulated by means of the hand-operated butterfly valve in the body of the nozzle.

Although we have no figures with regard to the power consumed by this plant per ton of grain per hour tests carried out on a somewhat similar plant in the neighborhood show that the expenditure is somewhat less that 1½

horse-power per ton per hour, which is a considerable improvement on earlier installations of the kind.

Fig. 7 is of special interest on account of the difficulties which have had to be overcome in adapting a pneumatic system to an existing situation. This plant is now in use at Carr's Flour Mills, Limited, Silloth, and is capable of dealing with 75 tons of grain per hour. The general principles on which it operates are similar to those of the above apparatus, but the pneumatic plant had to be so designed that it would not interfere with the operations of the existing hydraulic cranes A, or with the use of the railway siding B. It has to deal with the cargoes of both ocean-going and coasting vessels on tidal water, and the quay is encumbered by vertical columns, which support the crane girder. In order to get over these obstacles the main intake pipes L are made so as to be readily connected to and disconnected from the grain receivers F, and the receivers have to travel a certain distance. To do this they are suspended from rails carried by brackets underneath a loading out balcony C as shown. The intake pipes are suspended from a runway D, carried by brackets parallel with the quay and outside of the crane girder. This arrangement enables the pipes to be turned round and swung clear of the cranes. Owing to the restricted space available grain tipping mechanism such as that above described could not be used, and rotary seals G have to be employed. These are operated by electric motors through double spur reduction gear. There are six points along the quay at which the seals can be operated and connections made with the air mains. The seals discharge the grain on to conveyer belts J placed below the platform, which feed a silo at the end of the dock.

COMPRESSED AIR IN A SCOTTISH COLLIERY

At a meeting of the Scottish Branch of the National Association of Colliery Managers the presidential address, by Mr. Richard McPhee, described the system of compressed air haulage installed at the Bothwell Park Colliery. The colliery comprises two shafts both sunk to the splint coal. Owing to local conditions, the output of 1,000 to 1,100 tons per day of eight hours from both shafts is raised from the main coal level, 1,002 feet from the surface. The method of working is principally by long-wall.

The system of haulage is direct-rope and main-and-tail rope, with compressed air as the motive power. The air is compressed to 70 lbs. per sq. in. at the receiver by two engines, one of which is of Walker's latest type, steam end cross-compound and condensing, with double stage air compressor. The speed at which it travels is regulated by a governor operated by air pressure from the main pipe, and also by the usual mechanical arrangement. The other compressor is of the coupled-tandem single-stage compressor type.

THE PIPING.

The compressed air is conveyed down the pit in a line of cast-iron pipes 8 in. in diameter. At the pit-bottom two branches, each 6 in. in diameter, are taken off (one for each pit). There are nearly six miles of pipes, varying in diameter from 5 in. down to 3 in. in use to convey the compressed air into the workings. The 5-in. and 4-in. pipes have screwed-on flanges with six bolts to each joint; the 3-in. pipes have strong oval-shaped flanges with two bolts to each joint. These joints have given the utmost satisfaction during many years of use, under the most trying conditions of heaving pavements and crushing sides.

There are 21 haulage gears in the colliery, all having double cylinders varying in diameter from 6 in. to 9½ in., with drums varying in diameter from 20 in. to 3 ft. 6 in There are also 11 Tangye pumps with air cylinders varying in diameter from 4 in. to 12 in., and with pump barrels from 3 in. to 6 in., and lengths of stroke in proportion.

With one exception the seams worked have all bad roofs, which are further aggravated by working the one seam over or under the main roads of the other for commercial reasons. This compels the adoption of a system of haulage which can work in a small road, so that back brushing and repairing costs may be kept within proper limits. For many years secondary haulage by a mixed system of ponies and hand-drawing was in use, but owing to the heavy cost of maintaining the roads high enough for ponies, and the unreliability of the drawers, it was decided to abandon it, and to lay off the workings in such a manner that mechanical haulage could be applied right up to the face on slopes or

heading roads, leaving the men only the branch roads to draw. It was also decided where possible to apply conveyors on a line of face to give an output of coal large enough to justify the putting in of a separate haulage, the terminus wheel of which could be kept quite close to the bridge, thereby dispensing with ponies and hand-drawing altogether.

From the experience gained in the working of this extensive system of secondary haulage with compressed air as motive power, the writer believes the same results could not be obtained with electricity.

HIGH EXPLOSIVES*

BY PROFESSOR VIVIAN B. LEWIS.

PROPELLENTS AND HIGH EXPLOSIVES.

The difference between a "propellent" and a "high explosive" is entirely one of rapidity in explosion. In both cases they are bodies containing in a small space combustible material that can be burnt to form enormous volumes of gaseous products, together with oxygen-bearing radicals capable of carrying on the combustion with great rapidity independently of the exterior air. In gunpowder there is carbon in the form of charcoal, mixed with sulphur and potassium nitrate, the latter being the oxygen-carrying body, and on the powder being ignited a chemical action takes place, which liberates an amount of gas many hundred times the original volume of the powder. This conversion takes a measurable time for its completion, and a "propellent" is the result. On the other hand, when cotton is treated with the strongest nitric acid and mixed with sulphuric acid, the cotton fibre becomes nitrated, and a molecule is produced in which there are present the hydrogen and carbon of the cellulose, together with oxygen held in combination by the inert nitrogen of the nitrate radical. On such a compound being ignited it burns with considerable rapidity; but in a gun the rate of combustion is often accelerated, and a still more rapid form of explosion takes place.

It was in 1868 that one of Sir Frederick Abel's assistants, Mr. E. O. Brown, discovered that when a mercuric fulminate cap was exploded in contact with compressed guncotton the unconfined mass exploded with enormous violence, and that whereas an ordinary train of guncotton would take several seconds to burn a few feet, yet if compressed guncotton were detonated the explosion travels at the rate of 200 miles a minute, and as there is no time for the displacement of the air, the enormous volume of gas created having to find room for itself gives as great a destructive effect as if the guncotton had been tamped into a bore-hole in the object to be destroyed. Bodies which are capable of this accelerated form of explosion are said to be "high explosives," and unless the tendency to detonate can be overcome, as in the making of cordite from nitroglycerin and nitrocotton, they cannot be used as propellents, as there would be no time to overcome the *vis interia* of the projectile and the gun would be either strained or burst.

HIGH EXPLOSIVES TOO "HIGH" FOR USE.

Nitroglycerin is a very good example of a high explosive, but practically is of no use in Service work outside the manufacture of cordite, as it is far too dangerous to handle, and if used in a shell would be liable to premature explosion. It must always be remembered that science could provide explosives more powerful than those in Service use were it not quite as important to ensure safety for those using the explosive as to obtain destructive effects on the enemy.

EXPLOSIVE EFFECTS DOWNWARD

With most of these high explosives the explosion gives rise to its greatest effects in a downward direction, which may be explained by the fact that the decomposition is so enormously rapid that there is no time to displace the atmosphere, and the recoil from the attempt to push up an elastic medium like air causes the smashing down of rigid bodies below the seat of the explosion.

One of the things that strikes the ordinary observor most when considering the composition of the explosives of to-day is that they are all derived from substances of the most commonplace and harmless description. Cotton and glycerin when nitrated and blended with vaselin yield cordite, which serves as a propellent in all our guns, whilst the high explosives used in shells, torpedo heads, mines, and aviators' bombs, are almost entirely derived from coal tar derivatives by nitration.

*From a Fothergill Lecture delivered before the Royal Society of Arts.

COAL TAR DISTILLATIONS.

When coal tar is subjected to fractional distillation the portion which comes over up to a temperature of 150 deg. C. is called "light oil;" it contains all the compounds of low boiling-point found in the tar, and from this several of our most valuable explosives can be obtained. When these light oils have distilled over, the next fraction or "middle oil" yields phenol or carbolic acid, a body which when nitrated gives picric acid, the basis of the French high explosive melinite, the Japanese shimose powder, and the English lyddite.

In the manufacture of picric acid the fraction coming over on the distillation of the tar between 150 deg. and 200 deg. C., after the naphthalene has been allowed to settle out on standing, is agitated with a solution of caustic soda, which forms sodium phenolate with the carbolic acid. This sinks to the bottom of the vessel and is drawn off and treated with sulphuric acid, whereby the carbolic acid is set free. The acid mixture is fractionally distilled, and the phenol comes over between 180 deg. and 190 deg. C., crystallizing from the distillate in needle-shaped crystals. Phenol or carbolic acid when pure fuses at 42 deg. C. and boils at 182 deg. C. The phenol is mixed with an equal weight of concentrated sulphuric acid, and heated in an iron vessel to a little over 100 deg. C. When cold the mixture is dissolved in twice its weight of water, and added gradually to three times its weight of strong nitric acid, precautions being taken to prevent undue rise of temperature; when fuming has ceased steam-heat is employed to complete the nitrification. On cooling, crystals of picric acid separate out and can be purified by crystallisation.

PICRIC ACID.

Picric acid is a nitro-substitution product, three atoms of the hydrogen in the original phenol being replaced by the radical nitryl, and it forms with metals a class of salts called "picrates." The potassium salt was suggested as a bursting charge for shells nearly fifty years ago, whilst Sprengel showed it could be detonated, and, later, Turpin employed the acid itself as an explosive. It was found possible to get a great weight of explosive into a small space, as the acid could be melted and poured into the shell in a molten condition. Picric acid *per se* is a very safe explosive, but has the drawback of acting on metals to form picrates, some of which are far more sensitive to disturbing influences than the acid itself.

Experiences with lyddite shells in the South African War showed their behaviour to be very erratic, some exploding with great effect whilst others gave disappointing results. This was due to the fact that picric acid requires a powerful detonator for obtaining the highest explosive effect, and the use of such a detonator was dangerous and might cause a premature explosion of the shell within the gun.

The disadvantages inherent in the use of picric acid led to attempts being made to replace it by some other material of the same character, which could be used as a high explosive in a bursting charge and yet be free from these drawbacks. Such a body has been found in trinitrotoluol, and although its explosive force is slightly less than that of picric acid, the pressure of the latter being 135,820 lbs. on the square inch as against 119,000 for trinitrotoluol, yet its advantages more than compensate for this difference. Not being of an acid nature, trinitrotoluol, or T.N.T. as it is termed, cannot accidentally form more sensitive salts; it is without action on metals, and is perfectly stable.

TRINITROTOLUOL.

Trinitrotoluol is obtained by the nitration of toluene, which is contained in the crude benzol distilled from coal tar and washed out from coal gas, and forms one of the groups of so-called aromatic hydrocarbons. The crude benzol contains roughly—

Benzene	50	per cent.
Toluene	36	"
Xylene	11	"
Other bodies	3	"

The toluene is obtained by careful fractionation of the crude benzol, the boiling-point being intermediate between those of benzene and xylene:—

	Specific gravity.	Boiling-point.
Benzene	0.886	80.5
Toluene	0.869	110.0
Xylene	about 0.87	137—140

When coal is distilled at the lowest possible temperature the tar is fairly light as

regards specific gravity and of an oily character, is rich in paraffin hydrocarbons, and contains but few aromatic hydrocarbons. The distillation of a ton of coal yields about 20 gallons of such tar, the constituents of which are even of greater value than those of the high-temperature tar made in the gasworks and coke ovens of the Empire. On now raising the temperature of distillation of the coal to about that which used to be employed in the days of the old iron coal-gas retorts, a volume of coal gas, amounting to about 9,000 cubic feet, is yielded, the coke is harder in quality, and the tar shrinks from about 20 gallons to about 16 gallons to the ton. Tar made at this temperature contains a much higher proportion of aromatic hydrocarbons than that made at the lower temperature, and it is possible to obtain nearly a gallon of toluene per ton of coal distilled by recovery from both the tar and gas.

At the temperature used in practice at the present time for the manufacture of both coal gas and metallurgical coke, which is as high as the materials of which the retorts and ovens are constructed will stand, the aromatic hydrocarbons are largely destroyed or converted into naphthalene, and a third of a gallon of toluene is all that can be obtained from the tar and gas yielded by a ton of coal.

Toluene, to be used for the manufacture of trinitrotoluene, should be a clear water-white liquid, free from any suspended solid matter, and having a specific gravity of not less than 0 868 or more than 0.870 at 15.5 deg. C. Its boiling point must approximate closely to 110 deg. C., and 90 cc. shaken with 10 cc. of 90 per cent. sulphuric acid for five minutes should give only a slight colour in the acid layer after settling.

Trinitrotoluene.

The preparation of trinitrotoluene is carried out in three distinct stages, the toluene being converted first into the mono-nitro compound, which is then further treated with nitric acid at a slightly increased temperature to convert it into the dinitrotoluene, this being finally nitrated in sulphuric acid solution with strong nitric acid to trinitrotoluene.

On a large scale, trinitrotoluene is manufactured commercially from the orthonitrotoluene by a sulphonating process of the same character as that used in the manufacture of picric acid, and the crude crystals obtained in the final nitration are purified by solution in alcohol, filtration, and recrystallisation, the crystals being freed from alcohol in a centrifugal machine and air-dried.

Trinitrotoluene when pure has no odour and is a yellowish crystalline powder, which darkens slightly on keeping and has a melting point of 81.5 deg. C.; the presence in it, however, of isomers lowers its melting-point to 79 deg. C. It is perfectly stable and unaffected by contact with metals, forming no compounds with them even in the presence of moisture. It cannot be exploded by flame or strong percussion, and a rifle bullet may be fired through it without any effect on the mass. When heated to 180 deg. C., it ignites and burns with a heavy black smoke; but when detonated by a mercuric fulminate detonator the explosion is of great violence, and gives the heavy black smoke which has been such a characteristic of the high-explosive shells used in the present war. Even when detonated under water, as has been the case on several occasions with bombs aimed by aviators at vessels, a column of black smoke is thrown up above the surface of the water.

Black Smoke.

The formation of these volumes of black smoke on detonation of the T.N.T. has given rise to the names given to shells containg this explosive of "Black Marias," "Coal boxes," and "Jack Johnsons," and the fact that this cloud of carbonaceous matter is produced shows conclusively that the oxygen contained in the nitryl radical present in the explosive is insufficient for its complete combustion. An excellent explosive used during the Balkan War, and now largely employed by the Austrians and Russians, is known as ammonal, in which 12 to 15 per cent. of T.N.T. is mixed with an oxidising compound, ammonium nitrate, a little aluminium powder, and a trace of charcoal. This mixture gives even better results than the T.N.T. alone, and its only drawback is the hygroscopic character of the ammonium nitrate, which necessitates the material being made up in air-tight cartridges. It forms, however, a most effective bursting charge, and although the rate of detonation of the trinitrotoluene is reduced by the admixture of the oxidising compounds, the shattering effect is even more destructive than when

the explosive is used alone, as the pieces of shell scattered are larger in size.

An improved form of this explosive is being made on a large scale in England for use by the Allies, and renders the supply of high explosives for shells perfectly adequate.

Touluene is also being produced synthetically from other hydrocarbons by the action of heat and pressure, and it is safe to say that any requirements for toluene to nitrate can be amply met.

Under the influence of nitration other constituents of tar are converted into effective explosives, dinitro-benzol being the basis of such mining explosives as "Roburite" and "Bellite," whilst trinitrocresol has been used largely in place of picric acid under the name of "Ecrasite," but it shares with picric acid the drawbacks of forming more sensitive compounds with bases, and of having an acid reaction.

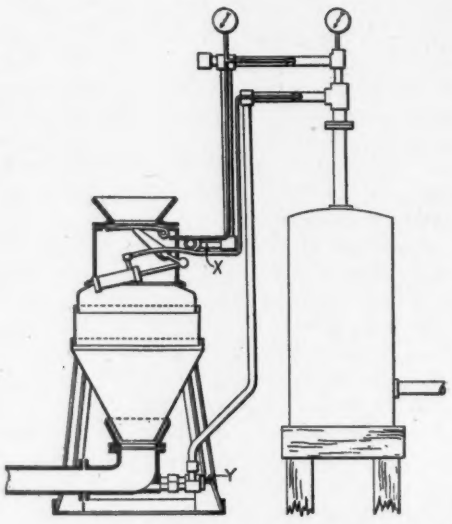
Probably the most powerful explosive known is made from benzene by converting it into anilin, and by nitration making this into tetranito-anilin, an explosive of which a great deal more will be heard, whilst another derivative, tetranitromethylanilin, known as "tetryl," is being used largely for detonators in place of mercuric fulminate.

PROPER REGULATING OF AIR PREVENTS CLOGGING OF PNEUMATIC MIXERS

BY H. A. LEEUW.

Proper application of an ample supply of compressed air has overcome clogging in the conveying pipe in placing concrete by the pneumatic method. This clogging has been the most serious drawback to the use of this method of mixing and placing concrete, which has developed until concrete has been placed at a distance of 2,800 ft. at the Mile Rock tunnel in San Francisco, and raised to a height of 60 ft. in building piers for a bridge at Magnolia, W. Va.

Owing to the way in which different aggregates behave in feeding into the conveying pipe, the air has to be supplied differently for stone and gravel. The illustration shows a cross-section of the mixer and inlet pipes, which are designated by *X* and *Y*. To illustrate the above statement, when gravel is used, it has been found that it was necessary



AIR VALVES ON CONCRETE MIXER.

to admit air only through the inlet marked *Y*, as an application through both would cause the material to feed too fast into the conveying pipe, and would result in a clogged pipe. When stone is used, however, it is necessary to apply the air through both inlets. If only the inlet *Y* is used, the material will arch and then suddenly fall down to the discharge pipe, causing it to clog.

It is very important to have a sufficient volume of air to carry the concrete through the delivery pipe to the forms. When this has not been properly taken care of, the concrete will drop in the delivery pipe and the next batch will stick on this and clog the pipe. The tendency has been to under-estimate the number of cubic feet of free air per minute required, as till lately there has been little information available on this subject. The following table

CUBIC YARDS OF CONCRETE PER HOUR, MIXER CAPACITY ½ CU. YD.

Actual amount of compressed air required. Cu. ft. of free air per minute	Length of Horizontal Discharge					
	100 Lin. Ft.	300 Lin. Ft.	400 Lin. Ft.	600 Lin. Ft.	800 Lin. Ft.	1000 Lin. Ft.
600.....	20	15	10	..	..	..
800.....	30	20	18	12	6	..
1200.....	40	30	25	20	12	8

shows the result of three years of study and practical experience. Present satisfactory installations are proving the correctness of these figures.

It has been found that the character of the sand plays a more important part, with refer-

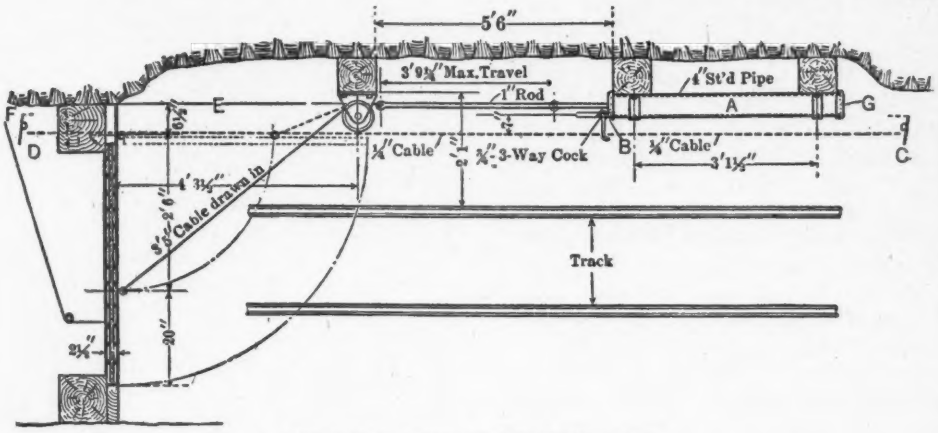
ence to the speed with which the mixture is carried through the pipe, than does that of the stone or gravel. A sharp, clean sand will require less air to move concrete mixed with it than one in which the percentage of loam or oxide of iron is high.

It has also been found that a pressure of 90 lb. per square inch gives the best results. This pressure, expanding into a 6 or 8-in. pipe, depending on the size of stone or gravel used, is reduced to a pressure averaging about 25 lb.

HOSE AT DELIVERY END REDUCES KICK

This high pressure has presented an obstacle to be overcome, as the delivery end must be securely fastened to take care of the kick resulting from this pressure. After considerable experimenting, it has been found that a hose, the lining of which is made of pure rubber to withstand the wear, and reinforced to take care of the thrust, when connected a short distance from the delivery end, acts as a shock-absorber, and allows the discharge end to be handled, so that the concrete is not all deposited in one place, but may be distributed in even layers. The mixture of the concrete placed in this way has been found to be as perfect as that delivered by any of the mechanical mixers on the market. When, however, the volume of compressed air falls below the amount required, as shown in the table the mixture shows a tendency toward segregation.

The pneumatic method is well adapted to tunnel lining, as it is possible to secure an increase of at least 50 per cent. in speed with a corresponding decrease in labor. The usual labor crew consists of six men for an outfit which is placing concrete at the rate of 100 cu. yd. in a 10-hr. day.—*Engineering Record.*



AUTOMATIC MINE VENTILATING DOORS.

COMPRESSED AIR AUTOMATICALLY OPERATES MINE VENTILATING DOORS

At Copper Queen Mine the fan draws the air down the Gardner and Spray shafts and forces the total quantity into the workings on the 900-level. Part of this air goes down to the 1,000-ft. and later comes up to the 900-ft., from whence all the air passes through stopes to the 800, 700 and 600-ft. levels, and exhausts through abandoned workings and upcast shafts. On the 1,000-ft. level the pressure is built up by the use of automatic doors. These doors not only hold the pressure, but also allow the air to circulate freely on the 1,000-ft. level. The usual speed of motor trains passing through these doors is about 7 miles an hour. The doors are 350 ft. apart. The arrangement for automatically opening the door is shown in illustration.

When the motor comes in the direction of *C* to *D*, the motorman reaches out and moves the lever *C* in the direction the motor is going. This opens the 3-way valve *B*, admits compressed air into the cylinder *A* and opens the door. When the train has passed through the door the motorman throws the lever *D*, which releases the compressed air and the door closes, assisted by the weights *E* and *F*. The valve *G* controls the speed of opening and closing of the door. The wires between *C* and *D* are crossed so that the levers are always moved in the direction the motor is

going in opening and closing the door. The distance between lever *C* and the door is 70 ft., which allows ample time for the door to open when the motor is coming at an ordinary rate. The distance between *D* and the door is 175 ft. This makes it possible for a trip of cars to be in front of the motor on the return and at the same time allow the door to be opened. The cost of upkeep is small and the entire equipment only requires the amount of attention usually given to any machine.—*Min. and Eng. World.*

ANEROID BAROMETERS FOR AVIATORS

BY P. RICHARD JAMESON, F. R. MET. SOC., F. R. S. A.

Ordinary aneroids provided with altitude scales such as tourists carry have been often used to determine the height of a flight. Needless to say, their results will not bear critical investigation, for these particular types are not adapted for work where rapid changes in atmospheric pressure take place.

Again, the construction of their dials is of a character that may cause many people to unknowingly use them incorrectly. A climb of hundreds of feet a minute of which certain aircraft are capable demands a differently constructed barometric mechanism than does a flight which consumes two or three hours in attaining the same elevation.

Altitude barometers are operated by a diaphragm opening or closing as changes in the weight of the air occur. There is a certain "lag" on all aneroid barometers, and it is impossible to absolutely eliminate it. The metal used in the diaphragm is of a very very fine gauge. In delicate instruments it is around 0.004 inches in thickness. This is corrugated and is circular in form, so that the corrugations offer elasticity. This diaphragm soldered around its edge appears as a small box. The air can now be exhausted from it. It naturally collapses, but a strong spring is fitted above it which draws it open again, keeping it in balance with the air. Any greater air pressure closes it, while a lesser air pressure enables the spring to open it more. This creates an up and down motion as the mechanism is taken to different air levels. By means of a series of levers this motion is transmitted to the dial. It is a well known fact that all altitude aneroid barometers need "recovery" after an ascent, for the hand will not often return immediately to its starting point, but will sometimes "recover" considerably in a few minutes, full recovery taking some hours, more often a day.

This is due to the "stress of metal" in the diaphragm; it is elastic, but has opened so rapidly that it has become somewhat strained and on its return to a low level remains "stretched" for some time, the amount differing in all instruments.

It is obviously necessary therefore to use an altitude instrument whose diaphragm is adjusted in such a manner that the maximum of "stretch" or "stress" has been removed by mechanical or other methods.

I have used altitude aneroids a great deal and have had considerable experience with them for the past twelve years and know this "stretch" and "rest" process to be a fact, and also that it varies with the instrument.

[In this connection the effect of changes of temperature, and the time required for equalization after such changes, should not be forgotten.—*Ed. C. A. M.*]

In ascents on Mount Cook, New Zealand, to elevations exceeding 10,500 feet; in the Himalayan Mountains in India to elevations exceeding 7,000 feet, both places showing extremes of temperature, I have found my ordinary pocket (3-inch) altitude barometer checked up very correctly, for no other reason than because it is a good instrument and because the ascents were slow and the "recovery" process did not occur, or else was taken care of in the course of the naturally slow ascent and descent. In returning to any base it has invariably checked up accuriately with standard instruments.

When used in an aeroplane it shows a considerable deviation from standard readings when it is brought to a low level, proving that it suffers as all altitude instruments from "stretch," but after a "rest" it completely recovers itself.

Special "aeroplane barometers" are constructed in some way to offset a great deal of this bothersome "stretch" and as a consequence they return to, or nearly to, their zeroes. I have in my possession a 4-inch instrument by Short & Mason, London, reading upwards to 7,000 feet, certified at the National Physical Laboratory, showing a maximum error of but 50 feet. It possesses only an equally divided altitude scale, which is really the one in which a pilot or observer is in-

terested. As this scale is made to revolve, the indicator can always be adjusted so that it starts its indications from the "O" feet reading.

This is impossible without error on the smaller size aneroids or types constructed for tourists to carry in the pocket, as their scales are unequal in division, and are correct only when the "O" feet of the altitude scale or the "31" inch mark on the pressure scale are coincident. Should the scale be moved from this point the error is against the aviator going in for "altitude," as the results indicated by the aneroid are less than the actual results attained by the machine. If the scaling on an instrument of this type be carefully examined it will be found to contract considerably in distance towards the end, so if the start of it or the "O" feet be moved from the correct point (which is "31" inches on the pressure scale) the value of it is all thrown off; that is, the indicating hand will be working in a part of the scale which should be more contracted in its divisions or vice versa.

Recording altitude barometers are being slowly but surely perfected. The manufacturers abroad are constructing on the experiences of aviators over there. The idea of a small cramped miniature article is sliding into oblivion, for those in a position to know realize that such instruments are useless. The Navy Department has in use instruments measuring about six inches in length and which record on a six-hour clock-drum to altitudes of 8,000 feet. They weigh but two pounds, which admits of a mechanism that can be depended upon for accuracy and stability and that will not "vibrate to pieces." As the length of the paper chart is about 8½ inches, the detail of the record can be studied with ease.

The test for indicating and recording aneroids is the same. The instrument is placed under a glass receiver in connection with a standard mercurial barometer. Before starting the test the instrument is made to agree with the mercury barometer as regards its reading.

The air is exhausted from the receiver, and due to the lessening pressure the aneroid mechanism operates, and the hand indicates at some point on the dial or chart. The mercury barometer changes also and gives the correct reading. If the aneroid under test does not agree with the mercury barometer a note is made of it and further tests carried on.

On getting the aneroid into "free" air again, certain parts of its mechanism can be adjusted to overcome the errors indicated under test, and it then again has to be tested. These tests are carried on until both instruments agree.

In my experience I have come to the conclusion that altitude instruments of all styles should be considered in the larger diameters, for, not only are they more accurate, but on account of the greater size all the adjustments, fittings, and delicate working parts can be made of length which admits of correct rating and allows the production of an instrument the results of which need never be criticized.

AIR LIFTS UNWATER A MINE

Air lifts were used at the mine of the Old Dominion Copper Mining & Smelting Co. at Globe, Arizona, in a recent emergency, when water flow increased on the upper levels of the mine and got beyond the pumping capacity of the plant. A 10-in. air lift raising the water 200 ft. (exclusive of friction), using air at 90 to 95 lbs. pressure at the power plant, required the following amount of air (measured by flow meter) at a barometric pressure of about 27 ins. of mercury.

Gals. Water per Minute.	Cu. Ft. Free Air per Minute.	Cu. Ft. Free Air per 1,000 Gal.
1,011	1,353	1,338
1,680	1,809	1,080
1,794	2,262	1,261
1,925	2,658	1,375
1,965	3,219	1,638

Another lift raising water 431 ft. exclusive of friction gave the following results:

Gals. Water per Minute.	Cu. Ft. Free Air per Minute.		Cu. Ft. Free Air per 1,000 Gal.	
1,122	3,051		2,718	
1,233	3,306		2,681	
1,233	3,484	3,395	2,825	2,753
1,291	3,832		2,968	
1,291	3,919	3,875	3,035	3,002
1,325	4,089		3,086	

In these tests, which were kept up from 1 to 2 hours each, the measurements of air were taken with a General Electric Co. air-flow recording meter installed carefully and checked after test according to instructions furnished by the makers; the results are probably cor-

rect within 5%. The measurements on water were obtained by taking the reduction of speed of the pumps when air lift was working and the water level in sump kept constant and a volumetric efficiency of 90% assumed for the pumps. All pumps were equipped with revolution counters. The average speed of the pumps was recorded before and after the air test to insure that the water flow had not changed in the mine. The quantities of water are very nearly correct. The above figures are not given as absolute, but only to give a rough idea of what can be done with an air lift. In both cases the submergence was about 190 ft.

[The above, which we reproduce from *Mining and Engineering World,* is of value as embodying a reliable statement of actual results secured by the use of the air lift, which more than most devices requires the suggestions which experience alone can give. It will of course be understood that this was an emergency installation and that the best conditions for economical operation could not be insisted on. For instance, it will be noted that the actual submergence, 190 ft., was the same in both cases, this being about 49 per cent. where the lift was 200 ft. and only 30 per cent. for the higher lift. If the submergence in the first case had been, say, 55 per cent. and in the latter case 45 per cent., the proportional air consumption should have been less.]

The two national forests of Alaska contain about 78,000,000,000 ft. of merchantable timber and it is estimated by the Forest Service that 800,000,000 ft. could be cut every year forever without lessening the forests' productivity.

It might easily be supposed that disease germs are comparatively modern, the diseases themselves having been developed by the conditions that have obtained since man appeared on the earth. Dr. Charles D. Walcott, secretary of the Smithsonian Institution, has discovered fossil bacteria in very ancient limestone from Gallatin county, Mont. They are 20,000,000 or 30,000,000 years old and consist of individual cells and apparent chains of cells which correspond in appearance with the micrococci of to-day.

THE DRILLS.

By Berton Braley.

Hear the clamor of the drills
As they bark,
As they batter the foundations
Of the everlasting hills
In the dimly lighted dark,
And the loud reverberations
Fill the murky stopes with sound,
Waking echoes underground!

Oh, there's music to the drills,
And it thrills,
For the clamor as they hammer
And they batter on the rock
Is a song of brave endeavor
And of hope and progress too.
For the drills are drilling ever,
Making dreams come true!

Hear the ringing, swinging measure
Of the drills
As they dig for buried treasure
Underneath the mighty hills;
How they shout in joyous mirth
In the caverns of the earth!

How they clatter as they shatter
All the locks that guard the ore.
And their song grows ever louder
As they bore, bore, bore,
Making ready for the powder
Which shall wrench the rocks asunder
With a sound of muffled thunder,
With a deep and mighty roar.

In the deepest nooks and niches
Go the drills,
Reaching for the hidden riches
And the buried wealth that fills
Nature's treasure houses deep.
So the gold that misers heap,
And the silver and the lead
And the copper rich and red—
They are all the fruit of toiling
Of the drills;
They are plunder from the spoiling
Of the hills;

So the heart of man beats faster
And his every fiber thrills
To the song that makes him master
Of the treasure of the hills,
To the yammer and the hammer
And the wild barbaric clamor
And the unrelenting war song
Of the drills.

Eng. and Min. Journal.

COMPRESSED AIR MAGAZINE

EVERYTHING PNEUMATIC

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JUST TO HELP THE NAVY

There be many things which all of us, and each individually, would have quite different if we could, but we have to take things as they are. Circumstances not of our making are crowding us as a nation and compelling sharp outlooking as to what may be before us. Violence and destruction are rampant and the thoughts of all true citizens in these times of unparalleled perplexity are necessarily turned to the nation's good right arm for the maintenance of its international status and for its sure defence if need be. We cannot think of ourselves alone, but must remember also our reciprocal duties in the brotherhood of nations, and for the fulfilment of these strength and armed equipment would seem to be essential.

Events unparalleled in history have been showing the world what a great navy might have done in the way of world wide devastation, and what a greater, stronger navy could do to circumvent it. Plans of world sweeping conquest were never so suddenly and so completely extinguished.

Geographical conditions, in view of the great outbreaking, urgently suggest to us that an efficient navy is our supreme national need, and this being conceded, for it is not our task to argue it, all practical means for devising and providing such an equipment should be diligently sought and honestly welcomed when found. The newly constituted Naval Consulting Board, and entirely regardless here of what it may ultimately accomplish, would seem at least to have common sense for its voucher. It may be assumed, if one be sufficiently optimistic, that in all essentials except magnitude, our existing navy, in organization, in personnel and in presumptive efficiency, is the equal of any, but, even so, nothing should be left undone which could contribute to its betterment.

Perhaps the most striking thing in connection with modern naval development is the rapidity with which ships and armament are successively superseded. For at least half a century it has happened continually that the latest, most confidently heralded products of the navy-yards of the world have in a single decade been regarded as obsolète and comparatively worthless, and the process of obsolence is perhaps more active and potent today than ever before, and none can tell what

new and radical departure may date from the experiences of the present raging wars.

These things being so, there is call for every possible contribution of skill and experience wherever obtainable to guide in the design, construction, equipment and management of the navy of the future, and it is scarcely to be conceived that the group of men selected as the most advanced thinkers and workers in their respective lines, with the endorsement of individual success and accomplishment, cannot be of practical service to the nation in this connection.

The fighters of renown have never forged their own weapons. The world's fighting equipment to-day is invented and manufactured by non combatants, and presumption remains largely in favor of the civilian as the actual man behind the gun. The man who handles the guns has of course the final say as to the weapons provided.

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BRASHEAR DAY AT THE EXPOSITION

One of the most noteworthy of the doings at the Panama-Pacific International Exposition was the presentation of a special commemorative medal to Dr. John A. Brashear, as Pennsylvania's most notable citizen. We must tell of it all too briefly.

Colonel A. G. Hetherington, Director of Art, Pennsylvania Commission, presided, and in opening the proceedings said in part:

We are assembled here for the purpose of honoring a Pennsylvanian, who has been chosen as one of the most beloved, if not the most beloved, of the men of our state. He comes here representing nine millions of people. He has been honored all over the world, but the gewgaws that have been given to him are nothing, because he has, with his great genius, journeyed throughout the Heavens, with its illimitable space. He has within him the heart of a child and the agility of a boy, both physically and mentally.

Frank S. Brown, Director of the Exposition, presented the medal to Dr. Brashear, saying in part:

It is my great pleasure and high privilege to

welcome here to-day Pennsylvania's most distinguished citizen, and to pay tribute to the genius of the man who has made not only his own state, but the nation illustrious.

Doctor Brashear is a man whom all the world honors for his accomplishments and above all for that sweet courtesy and kindliness of heart that has endeared him to his friends and to the people of Pennsylvania. When we consider his accomplishments and how he has made possible for those of us who walk on this earth to behold the wonders of the Heavens and to get our inspiration from the planets that are moving through infinite space, surely we can say that to Doctor Brashear may be applied George Eliot's attribute: "The world is but made better for his presence."

In behalf of the Board of Directors of this great Exposition, it is my high privilege to-day to present to Doctor Brashear this bronze medal, typifying as it does the efforts of the human race for more than four centuries in the development of the civilization on the western coast, the efforts of the people of the United States in the completion of the Panama Canal that made possible the linking of all the world together, the energies of the people of San Francisco in the rebuilding of their city, and last, but not least, the building of this magnificent Exposition, which commemorates the achievements of such men as Doctor Brashear and the men of the engineering profession, and so, Doctor, I ask that you accept in behalf of the President and Board of Directors of the Panama-Pacific International Exposition this bronze medal, carrying with it our love, our gratitude, and our appreciation of what you have done for this nation.

Doctor Brashear, in accepting the medal, said he could not conceive why the State of Pennsylvania had gone into the rolling mill and selected a mechanic as its leading citizen, when it had such men as Russell Conwell and John Wanamaker. He continued:

I must, however, say a few words of appreciation of the very kindly address that our good friend has given us in presenting me this medal. His words of praise are far more than I deserve, and far more than I shall be able to acknowledge in my response.

What I best love to say is that, although we may be great engineers, great scientific men or women, but whatever we are, it is our duty to have something else to do, as our good friend Mr. Brown has said, for the uplift and betterment of humanity, and the man or woman who cannot leave a record of having done something of the kind for the world, has lived in vain.

"It may be only a glad good morning
As we pass along the way,
But it will leave a ray of sunshine
Over the live-long day."

I want everybody to go from this place and forget me, but think of the other fellow, whom you can help out of the shadow into the sunlight of this old world. You can all do something. There is a greater accomplishment than that performed by our good friend Brown and his associates in the construction of these magnificent Exposition buildings—a greater work than we engineers and you officials have done in your calling—a greater work than the building of the Panama Canal, which has connected the two oceans. It is ours to break down the conditions that are damning this old world of ours by war, by affliction, by suffering, and by death. You and I can help to do it, everyone of us. Let us all, whether we get medals or not, do what we can to make this old round world run smoother on its bearings, by pouring the oil of joy upon them rather than the spirit of heaviness.

NEW BOOKS

Hydraulic Turbines, with a chapter on Centrifugal Pumps, by R. L. Dougherty, Second Edition, revised and enlarged. McGraw-Hill Book Company, New York. 200 pages, 6 by 9 in. 100 cuts and numerous tables, $2.00 (net).

This book embodies both theoretical and practical data bearing upon an important but highly specialized industry. A general idea is given of the conditions affecting turbine operation, the principles of construction and operation of modern turbines, the theory and characteristics of the principal types, commercial constants, means of selection of type and size, costs of turbine and other water power and comparisons with steam power. A valuable chapter is added on centrifugal pumps, with an appendix comprising full data from numerous actual tests. There is also a comprehensive series of review questions and problems.

Bulletin 98. Report of the Selby Smelter Commission, by J. A. Holmes, E. C. Franklin and R. A. Gould. 1915. Government Printing Office, Washington, D. C. 528 pages, 41 plates, 14 figures. Paper covers $1.25.

This voluminous publication embodies the results of elaborate and protracted investigation. It describes in detail the methods used, some of them new, in determining the contamination of the air and the damage to trees, crops and live stock by the smoke and fume from the Shelby Smelter in California, and gives the conclusions of the Commission on the methods used by the smelter company to prevent injury.

SAFETY IN STONE QUARRYING

The above is the title of a valuable paper (Technical Paper 111) by Oliver Bowles, recently issued by the Bureau of Mines and ready for free distribution. The Bureau, in connection with its work relating to the increase of safety in the mineral industries, is investigating quarries, and quarrying methods. This paper describes the results of an investigation of safety conditions in stone quarrying—more especially in the quarrying of marble. Its purpose is to point out the chief causes of accidents in stone quarries and to suggest preventive measures and devices. Many of the suggestions are applicable to all types of rock excavation, but relate chiefly to marble quarrying. Accident prevention is considered from three points of view—safety in equipment, safety in quarrying methods, and safety through proper care. The paper also describes methods of first aid in case of accident and includes a list of typical quarry accidents that have come to the writer's notice.

COMPRESSED AIR AS A DETECTOR OF SUBMARINES

It will be remembered that our issue for March of the present year contained an illustrated description of the Brasher Air Breakwater, which employs submerged pipes discharging compressed air up through the water, thus giving some elasticity to the waves and robbing them of their destructive force of impact. Mr. Brasher now suggests another possible application of his device which we present in his own words.

"Compressed air used in this way," writes Mr. Brasher, "would be the easiest and most satisfactory method of detecting enemy submarines that might try to penetrate any of our harbors or bases. If there is a line of perforated pipe across the channel or path through which the submarine must pass, and compressed air is forced through the pipe, there is an uninterrupted line of bubbles showing on the surface of the water. The minute that the submarine pokes its nose into this line of bubbles there will be a blank, smooth streak or break in the line of bubbles indicating exactly the spot where that submarine is crawling up the channel.

"I have spoken of this to a prominent officer of the General Staff, and he agrees with me that it could be made most valuable. He said that as soon as the position of the submarine was thus pointed out it would be a comparatively simple matter to destroy it, either by means of patrol boats or by contact mines. There is another feature, too, which should be considered, and that is that any submarine commander would hesitate to send his boat through a continuous screen such as would be formed by air liberated in this way, for it might suggest any kind of a trap directly behind it. My adviser seemed to think that it could be very easily demonstrated at Fortress Monroe."

NOVEL IMPROVEMENT IN STEAM DRIVEN COMPRESSORS

Present day steam engineering is marked by the wider use of high pressure and superheating. This condition has rendered unsatisfactory the use of the familiar slide valve gear, even of the adjustable cut-off type, for steam driven air compressors. The slide valve in various forms has long been standard on air compressing units below the sizes (about 24" stroke) where the Corliss valve becomes commercially practicable. At high temperatures the slide valve is quite objectionable on account of its tendency to warp, with consequent leakage. There is also increasing difficulty of lubrication which results in greater wear and a greater consumption of power in driving the valve.

To provide a steam driven compressor which will operate satisfactorily with high pressure and superheat, as well as at more moderate pressures, there has been developed and

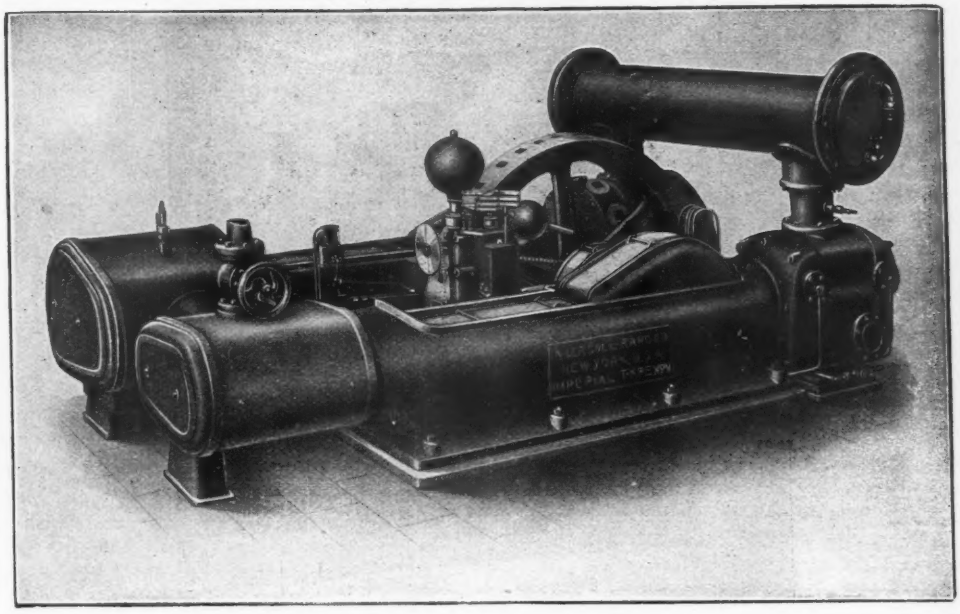


FIG. I. IMPERIAL COMPRESSOR. TYPE X P V.

perfected a Balanced Piston Steam Valve gear, which has been incorporated in the design of the standard "Imperial" Duplex Air Compressors.

The use of a balanced valve makes it possible to control the machine in the only really economical manner—by automatically varying the point of cut-off in the steam cylinders. This method of regulation maintains constant speed for changing steam pressures and also adjusts the speed of operation to the demand for air. Steam is admitted to the steam cylinder at full boiler pressure, and without the wire-drawing of a governor of the throttling type, which means that the machine automatically operates at its highest efficiency. It is pointed out that the higher the steam pressure the greater the relative increase in efficiency.

With the hand-adjusted cut-off valves usually set at 5/8 or 3/4 stroke, the steam economy is admittedly poor, while with an auto-

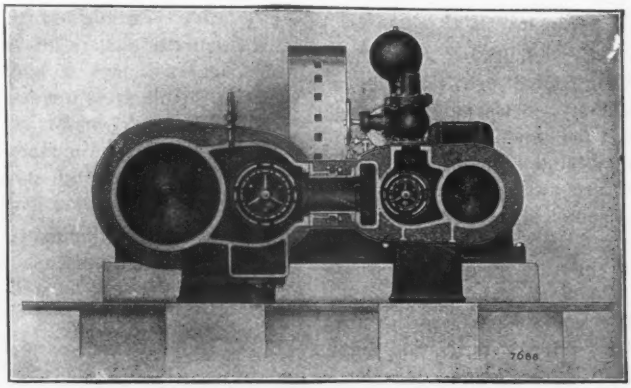


FIG. 2. VERTICAL CROSS SECTION.

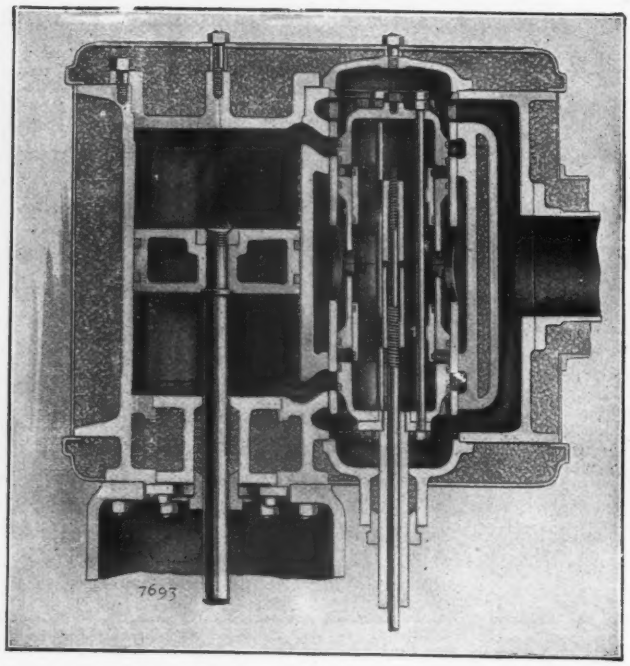


FIG. 3. PLAN IN SECTION.

matic cut-off regulation of wider range the saving in actual steam consumption is the point most emphasized by the manufacturer.

This piston valve is a perfectly balanced valve of the telescopic type. The cut-off valves are right and left hand threaded to a cut-off valve rod. Steam admission is through the center of the valve, the steam then passing through the valve ports to the cylinder and then being exhausted by the ends of the valve. It is to be noted that this construction exposes the valve chest covers and steam packings to exhaust pressure only, proportionately reducing the liability of leakage. The design and the even distribution of metal in the Imperial Piston valve are claimed to preclude any possibility of warping, and the valve is so balanced that friction is minimized and lubrication facilitated.

The steam ports are large and unsually direct. Exceptionally complete insulation, the separation of the live and the exhaust steam passages and the fact that the steam chest partially encircles the cylinder contribute to the steam economy. These points will be readily appreciated from the sectional illustration Fig. 3. The cylinder and receiver lagging is covered with a sheet iron casing and that of the cylinder heads with neatly fitting cast covers.

The unique steam receiver is a direct connection between high and low pressure steam chests. The low pressure chest is proportioned to furnish additional capacity and is so located that the heat ordinarily lost by radiation is used in heating the cylinder and valve. A special expansion joint prevents any possibility of cylinder alignment being impaired.

The governor is a speed and pressure regulator which varies the cut-off by automatically rotating the cut-off valve rod and changing the relative positions of the cut-off valves. It is essentially a chain driven rotary oil pump which acts against a weighted plunger. The variation in oil pressure due to the changing speed of the compressor, or the varying air pressure through the movement of the plunger, changes the cut-off point in the steam cylinders.

This governor is claimed to be entirely automatic in operation and capable of maintaining exceptionally reliable, as well as close, regulation.

Lubrication of both air and steam cylinders and valves is provided for by force feed oilers.

The other features of the new compressor, called by the maker "Imperial" Type XPV, are those of the "Imperials" now in service; wholly enclosed main frames containing the reciprocating parts, automatic lubrication by the bath system and the standard Imperial completely water jacketed air compressing cylinders.

This "Imperial" Type XPV compressor is a product of the Ingersoll-Rand Company, 11 Broadway, New York, and is built in capacities from 608 to 3,620 cubic feet per minute, and for discharge air pressures from 10 to 110 pounds per square inch.

NOTES

Of the fatal accidents which occur in Illinois coal mines, one half are caused by falls of roof and coal, and 18 per cent. by pit cars. Explosions are responsible for only 7 per cent. In the different districts of the State as a whole there are produced 170,478 tons of coal for each man killed and 24,194 tons for each one seriously injured.

The curious action of sea water upon steel under certain conditions is exemplified in the case of the half-a-million-dollar pleasure yacht Sea Call which after just six weeks of life on the ocean wave had to be broken up to prevent her sinking. It is understood that the plating was fastened to the steel frames without the interposition of zinc, which is said to be the successful practice in the navy.

In proportion to the numbers employed, more men are killed in the metal mines of the United States then in the coal mines. In the latter large numbers are sometimes killed at once, while in the metal mines single fatalities are of more frequent occurrence. For the three years 1911-1913, inclusive, the annual average of killed per thousand was 3.60 in coal mines and 4.08 in the various metal mines.

Ordinary blasting powder is not affected by the cold, but in warm damp weather it is liable to take up moisture and thus lose strength. It is made up largely of nitrate of soda with 10 to 15 per cent. sulphur and charcoal, and contains no liquid ingredient. Ordinary handling and shaking in transportation does not affect it. It is the nitrate of soda that attracts the moisture in the air.

It may be worth while next April to look again at the following mid-October item: "The old-time Indians of the Southwestern States are prophesying an usually long, cold winter. They say that the squirrels have already begun storing up goods, the bark on the trees is thicker than ordinarily, the summer has been abnormally cold and wet, the migration of birds started very early and numerous other signs which according to the aborigines never fail all go to forecast a winter of unusual severity."

When fuse is so stiff and brittle as to break open in being handled, its water resisting qualities are impaired. If fuse is allowed to become too old before it is used, there is danger that the varnishes will be dry and hard, or that the powder may become impaired by age, although such results are not liable to occur for several months, if the fuse is properly stored. Guttapercha fuses are the most liable to deterioration for the reason that guttapercha, rubber, and other vegetable matter of this nature, are subject to oxidation from contact with air.

Illium is the name given to a new acid-resisting alloy worked out at the University of Illinois, and described by S. W. Parr at the recent convention of the American Institute of Metals. Its composition is given as: Copper, 6.42 percent; Manganese, 0.98; Silicon, 1.04; Tungsten, 2.13; Nickel, 60.65; Aluminum, 1.09; Iron, 0.76; Chromium, 21.07; Molybdenum, 4.67; total 98.81 per cent; Carbon and Boron not determined. It is said to be entirely resistant to 25 per cent. nitric acid. Its properties are ascribed to a proper proportioning of electro-positive and negative metals.

LATEST U. S. PATENTS

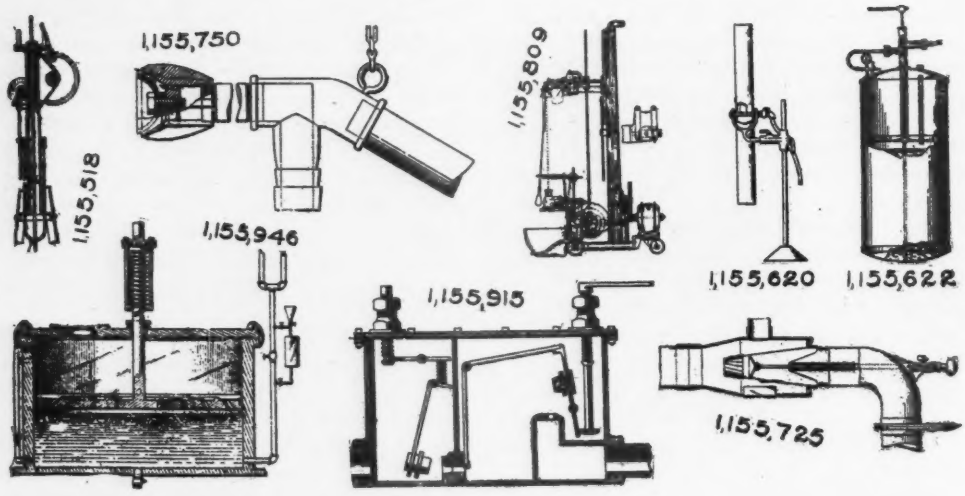
Full specifications and drawings of any patent may be obtained by sending five cents (not stamps) to the Commissioner of Patents, Washington, D. C.

OCTOBER 5.

1,155,518. WINDMILL. DANIEL R. SCHOLES, Chicago, Ill.

1,155,530. PROCESS FOR FINISHING BREAD AND THE LIKE. ARNOLD S. WAHL, Chicago, Ill.

3. The herein described process of finishing bread and the like, which consists in surrounding the same while cooling, after baking, with an atmosphere free from oxygen.



PNEUMATIC PATENTS OCTOBER 5.

4. The herein described process of finishing bread and the like, which consists in surrounding the same while cooling, after baking, with an atmosphere of carbon dioxid.

1,155,571. PNEUMATIC ACTION FOR PLAYER-PIANOS. OTTO HIGEL, Toronto, Canada.

1,155,594. COMPRESSED-AIR HYDRAULIC PUMP. ATTILIO MARIOTTI, Florence, Italy.

1,155,620. AIR-INJECTOR. WENZEL SCHEICK, Waterbury, Conn.

1,155,622. PRESSURE-TANK FOR VAPOR-LAMP SYSTEMS. EDWARD SEITZ, Peoria, Ill.

1,155,725. AIR-FEED FOR PULVERIZED FUEL. SIMON HENRY HARRISON, Easton, Pa.

1,155,750. TUBE-BLOWER. EUGENE J. MCCARTY, Clinton, Mass.

1,155,809. GLASS-BLOWING MACHINE. NOBLE W. HARTMAN, Toledo, Ohio.

1,155 915. AUTOMATIC FLUID-PRESSURE CUT-OFF. MARTIN L. GROVE, Tylersburg, Pa.

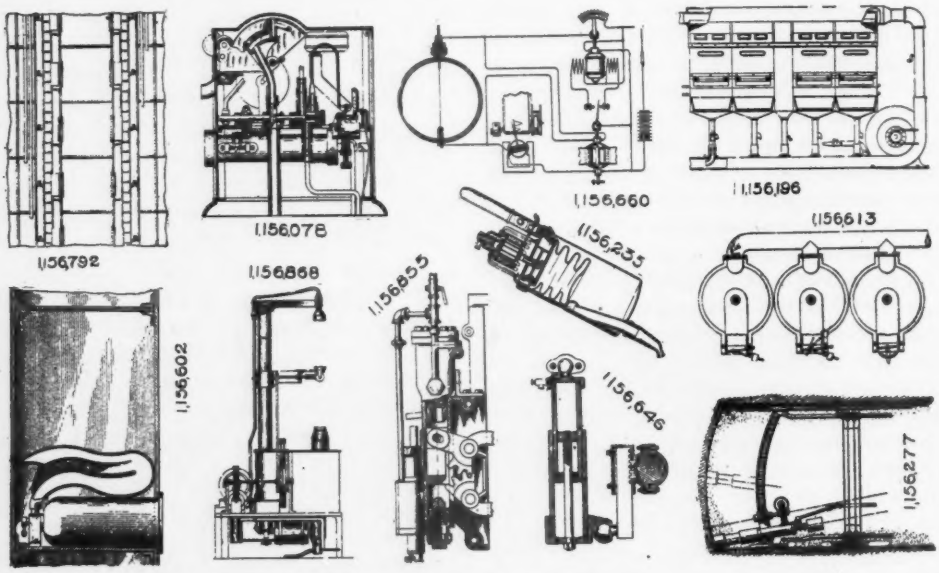
1,155,946. COMBINED VACUUM WASHING AND WRINGING MACHINE. SHREWSBURY B. MILLER, Fairmont, W. Va.

OCTOBER 12.

1,156,056-7-8. MOLD MECHANISM FOR GLASS-BLOWING MACHINES. BENJAMIN DAY CHAMBERLIN, Corning, N. Y.

1,156,078. AIR-VENDING MACHINE. ARTHUR PEART HOLDEN and ROBERT JAMES COPELAND, Toronto, Ontario, Canada.

1,156,118. CENTRIFUGAL FAN. ROBERT WARG, Milwaukee, Wis.



PNEUMATIC PATENTS OCTOBER 12.

1,156,196. PNEUMATIC SEED AND DUST CONVEYER FOR COTTON-GINS. SILAS WILLIS, Noble, Okla.

1,156,235. HANDHOLD VACUUM-CLEANER. JAMES B. KIRBY, Cleveland, Ohio.

1,156,278. VACUUM-HORSESHOE. JAMES M. DOVE, Chicago, Ill.

1,156,277. TUNNELING-MACHINE. WILLIAM E. DEAN, Superior, Wis.

1,156,602. COMPARTMENT-INFLATER FOR SHIPS. MORRIS KASSER and JOSEPH B. KASSER, San Francisco, Cal.

1,156,613. CENTRIFUGAL COMPRESSOR. SANFORD A. MOSS, Lynn, Mass.

1,156,646. SHOCK-ABSORBER. RAYMOND R. WALKER, Follansbee, W. Va.

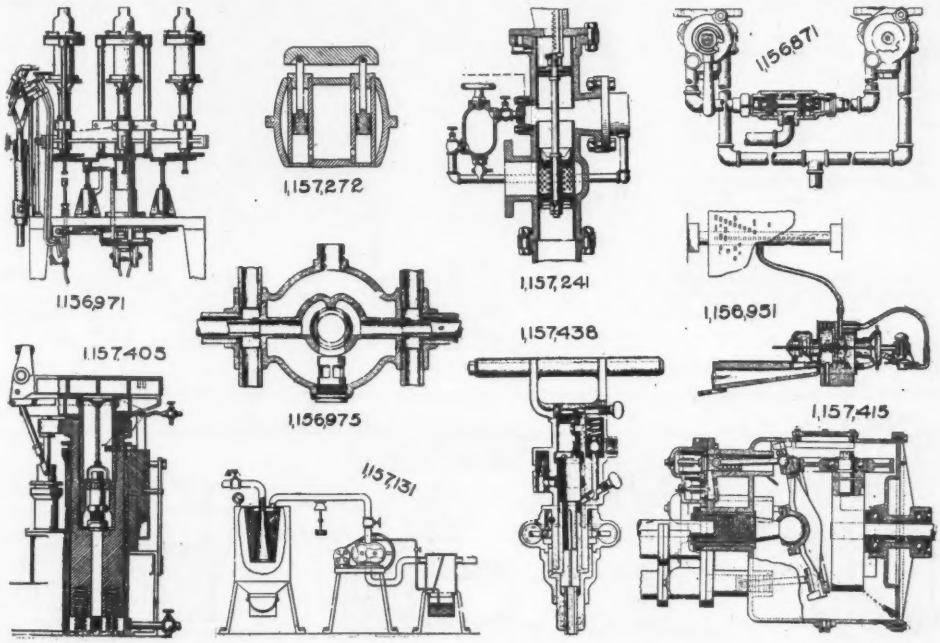
means for actuating said valve mechanism, and a single governing device actuated by outside air for controlling the operation of the motor means.

1,156,971. MACHINE FOR THE MANUFACTURE OF VACUUM-RECEPTACLES. WILLIAM R. BURROWS, Newark, N. J.

1,156,975. DEVICE FOR MIXING GASES. ALBERT CHARLES CLARK, Chicago, Ill.

1,157,131. METHOD OF CLEANING SCREENS OF VACUUM CLEANING APPARATUS. WILLIAM S. SUTTON, Rockford, Ill.

The method of cleaning the screen in the separator of a vacuum cleaning apparatus which consists in sealing the air intake, exhausting the air from said separator, discontinuing said exhaust-



PNEUMATIC PATENTS OCTOBER 19.

1,156,660. METHOD AND APPARATUS FOR MEASURING THE FLOW OF FLUIDS. ERNST J. BERG, Schenectady, N. Y.

1. The method of measuring the flow of steam, air and other fluids, which comprises determining the amount of energy required to maintain at a constant temperature a body upon which said fluid exerts a cooling action as it flows.

1,156,792. PNEUMATIC CONTROL OF INFLOWING WATER IN DAMAGED SHIPS. ARTHUR RICHARD MCAVOY, Collie, Western Australia, Australia.

1,156,855. FLUID-ACTUATED MOTOR. GEORGE AKANS, Atlanta, Ga.

1,156,868. GLASS-BLOWING MACHINE. VERNON M. DORSEY, Laurel Grove, Md.

OCTOBER 19.

1,156,871. BRAKE-VALVE DEVICE. BURTON S. AIKMAN, Milwaukee, Wis.

1,156,874. SUCTION-CLEANER. EDWARD M. BARNES, Hastings, Mich.

1,156,951. PNEUMATIC PIANO-PLAYER. EUGENE C. WAMELINK, Cleveland, Ohio.

1. In a piano player, a tracker board, a chest, a power pneumatic for each note, valve mechanism for controlling each power pneumatic, motor

ing operation and sealing said separator, and then causing a series of sudden inrushes of air, at atmospheric pressure, to enter said separator in a direction opposite to that of the flow of air during said exhausting operation whereby to produce a series of pulsations of compression shocks within said separator acting upon said screen to dislodge solid matter adhering thereto, substantially as specified.

1,157,144. AUTOMATIC TRAIN-STOPPING MECHANISM. WERNER BEUTEL, Bridgeport, Conn.

1,157,216. AUTOMATIC AIR-EXHAUST FOR CENTRIFUGAL PUMPS. CARL E. GRUNSKY, San Francisco, Cal.

1,157,241. LUBRICATING SYSTEM. HARRY C. MARTIN, Philadelphia, Pa.

1,157,272. RESILIENT WHEEL. CHARLES A. WHALE and JAMES H. BLACK, Portland, Oreg.

1,157,398. PNEUMATIC ACTION. CHARLES J. JOHNSON, Chicago, Ill.

1,157,403-4-5-6. MOLDING-MACHINE. WILFRED LEWIS, Philadelphia, Pa.

1,157,415. FLUID - POWER - TRANSMITTING APPARATUS FOR VEHICLES. HORATIO N. NORTON, Mount Vernon, N. Y.

1,157,430. PNEUMATIC TOOL. MATHER W. SHERWOOD, Franklin, Pa.

1,157,456. VACUUM-CLEANER. JAMES H. TAYLOR, Toledo, Ohio.

OCTOBER 26.

1,157,682. LOADING APPARATUS OF HEAVY GUNS. ARTHUR TREVOR DAWSON, Westminster, London, and JAMES HORNE, Barrow-in-Furness, England.

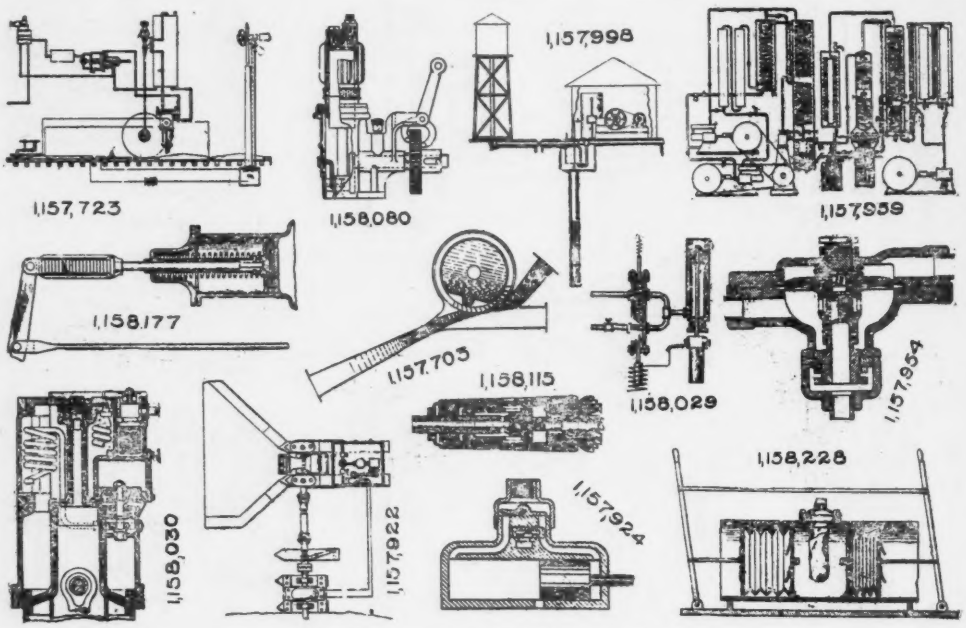
1. In gun loading appafatus the combination with the slide frame, the rammer actuating motor carried thereby, and the motor control hand lever mounted on a part of the mounting that does not move in elevation, of a control valve carried by the slide frame, and pressure fluid means for actuating said valve from the aforesaid hand lever.

1,157,703. WET VACUUM-PUMP OF THE ROTARY TYPE. MAURICE LEBLANC, Val-sur-Seine, Croissy, France.

erable external work the unliquefied gaseous residue of such portion along with the other portion; and finally partially releasing from pressure the liquid thus obtained and sub-cooling therewith the unreleased liquid.

1,157,998. AIR-LIFT-PUMP BOOSTER. FRANK S. MILLER, Indianapolis, Ind.

1. In combination, a closed chamber, a pipe leading from a well into such chamber and opening into said chamber above the liquid level therein, an air nozzle in such pipe below such chamber, a pipe leading from such chamber and opening into such chamber below the liquid level therein, a downwardly opening hood located in said chamber and having its open lower end below the liquid level therein, said first named pipe discharging upwardly into said chamber and said last named pipe opening under said hood,



PNEUMATIC PATENTS OCTOBER 26.

1,157,723. APPARATUS FOR CONTROLLING RAILWAY-TRAINS. JOSEPH O. QUERY, Somerville, Mass.

1,157,859. OZONE-GENERATOR. WILLIAM O. FREET, Hackensack, N. J.

1,157,922. WATER-POWER PLANT. ELMER BASSETT, Shelbyville, Ind.

1. In a water power plant, the combination with a water wheel, of pneumatic pistons and cylinders for raising and lowering said wheel, a pump for supplying compressed air to said pistons, an electric motor for driving said pump and an electric generator for supplying current to said motor driven from said wheel.

1,157,924. PNEUMATIC TOOL. CHARLES CHRISTIANSEN, Gelsenkirchen, Germany.

1,157,954. AIR-RETAINING VALVE FOR AIR-BRAKE APPARATUS. SPENCER G. NEAL, Los Angeles, Cal.

1,157,957. FLUID-PRESSURE REGULATOR. ARNOLD PFAU, Milwaukee, Wis.

1,157,959. ART OR PROCESS OF LIQUEFYING AIR AND SEPARATING THE SAME INTO OXYGEN AND NITROGEN. JAMES F. PLACE, Glen Ridge, N. J.

1. The process of liquefying atmospheric air, which consists in compressing the air, cooling the same, and liquefying a part of one portion thereof and expanding with production of recov-

and an automatic air valve controlling the outlet of air from and maintaining a pressure greater than atmosphere in said chamber.

1,158,029. FLUID-PRESSURE DEVICE. CHRISTIAN DANTSIZEN, Schenectady, N. Y.

1. The combination of a cylinder, a piston therein arranged to be urged in a given direction, a conduit for delivering a fluid under pressure to a chamber of said cylinder to urge said piston in the opposite direction, a conduit for discharging said fluid, and means for varying at will the ratio of delivery of said fluid with respect to the discharge thereby varying the position of the piston in said cylinder.

1,158,030. COMPRESSOR. HEINRICH DESCHAMPS, Charlottenburg, Germany.

1,158,067. PNEUMATIC ACTION FOR PIANO-PLAYERS. NELS MAGNUSON, Fort Wayne, Ind.

1,158,080. AIR-PUMP. JOHN K. STEWART, Chicago, Ill.

1,158,115. PERCUSSIVE TOOL FOR SCALING TUBES. HARRY SAMUEL BICKERTON BRINDLEY, London, England.

1,158,177. SLACK TAKE-UP FOR FLUID-PRESSURE-BRAKE SYSTEMS. GEORGE CHRISTENSON, Jamaica, N. Y.

1,158,228. PUMPING MECHANISM. LAWRENCE S. KASKIE, Rock Valley, Iowa.

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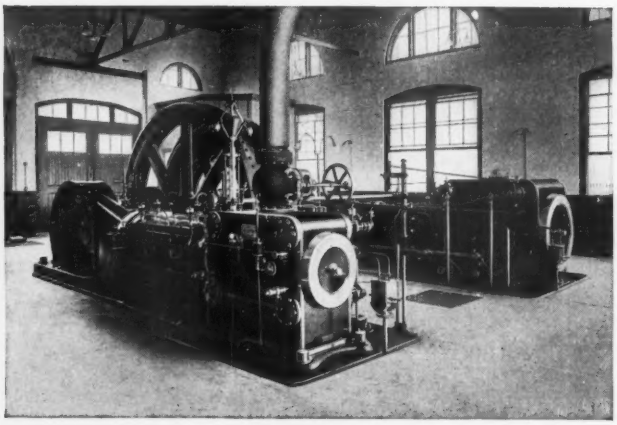

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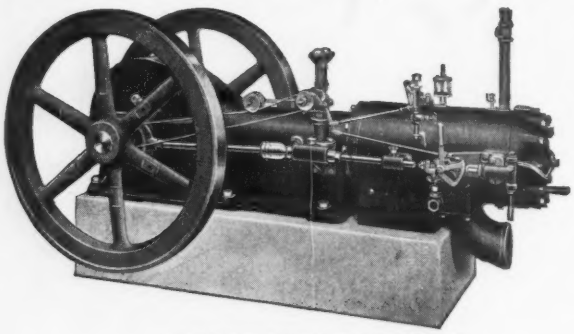

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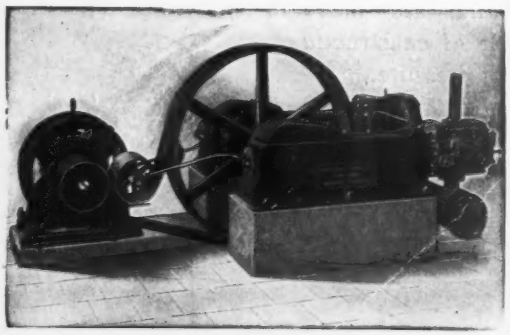

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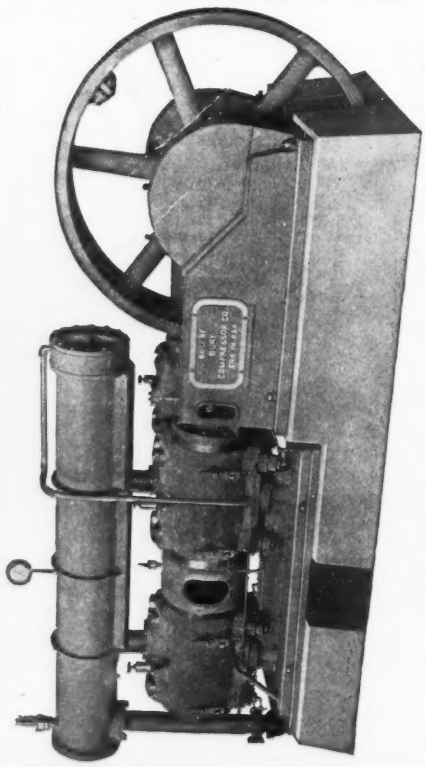

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